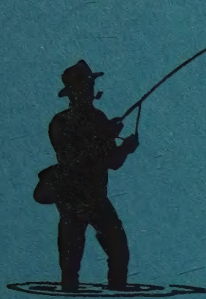


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SPORT FISHERY ABSTRACTS

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DEPARTMENT OF THE INTERIOR
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BUREAU OF SPORT FISHERIES AND WILDLIFE

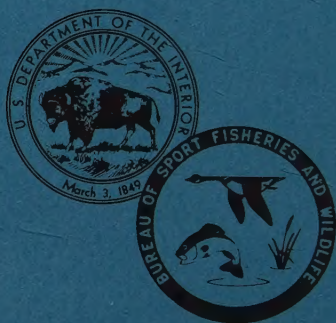
DEPARTMENT OF THE INTERIOR

Walter J. Hickel, Secretary

U. S. FISH AND WILDLIFE SERVICE

BUREAU OF SPORT FISHERIES AND WILDLIFE

John S. Gottschalk, Director



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SPORT FISHERY ABSTRACTS

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Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of published articles on limnology, ecology, natural history and other fields of specialization are included when the subject has application to the conservation and management of sport fishery resources.

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10402. Great Lakes Fishery Commission (Great Lakes Fish. Comm., Ann Arbor, Mich.). 1967. ANNUAL REPORT FOR 1965. Great Lakes Fish. Comm. Ann. Rept. 1965. pp. 5-61.

This annual report concerns itself with the reduction of lamprey and control. Early attempts to control sea lamprey by blocking their spawning streams with mechanical and electrical barriers were discontinued in 1960 when it was found that chemically treating streams to destroy larvae was more effective. Since the reduction of lamprey in Lake Superior, the survival of lake trout has improved and older fishes have become more abundant. In order to expedite the recovery of the population, the annual catch of lake trout in Lake Superior has been restricted to about 90,000 fish which are taken for biological information. Some lake trout populations on offshore grounds are approaching a state where they can soon support fishing operations on a moderate scale, but inshore populations require continued protection until natural reproduction is reestablished. This report also contains administrative matters, and news of the new committees and a report of the Chairman.

10403. Aronov, M.P. 1966. ON THE GROUP BEHAVIOR MECHANISM OF FISH. (K voprosu o mekhanizmaxh gruppovogo povedeniya ryb). In: Report Summaries of the All-Union Conference on the Ecology and Physiology of Fishes, 1966. Moscow. 129. From: Ref. Zh. Biol., 1967, No. 21146. (Translation); Biological Abstracts, 48(20): Abst. No. 99467. 1967.

A study was made of the reaction of perch, pickerel, surmullet, bass (of the genus Serranus) and of some blackfish to their mirror image. An individual as well as a species specific response was observed, which was most clearly marked in pickerel, feebly expressed in surmullet and indefinite in bass.

10404. Shiraishi, Yoshikazu. 1966. THE INFLUENCE OF PHOTOPERIODICITY ON THE MATURATION OF AYU-FISH, Plecoglossus altivelis: V. THE EFFECT OF REMOVAL OF THE EYE ON MATURATION. Freshwater Fish. Res. Lab. Bull., 15(1): 85-90. Illus. (In Jap. with Engl. summ.); Biological Abstracts, 48(20): Abst. No. 99608. 1967.

Experiments to ascertain whether the eyes play the role of receptor of such light stimuli were made by removing both eyes or one eye of the fish and rearing them with normal fish under 16 hours and natural day-length. There were no distinct differences among normal, one-eyed and eyeless fish.

10405. Thines, G., and E. Vandenbussche (Center Rech. Zootech., Univ. Louvain, Belgium). 1966. THE EFFECTS OF ALARM SUBSTANCE ON THE SCHOOLING BEHAVIOUR OF Rasbora heteromorpha Duncker IN DAY AND NIGHT CONDITIONS. Anim. Behav., 14(3/4): 296-302. Illus.; Biological Abstracts, 48(20): Abst. No. 99610. 1967.

The effects of the specific alarm substance on the cohesion of four schools of R. heteromorpha was studied on the basis of photographic records of the schools made in light and darkness at different moments of the 24-hour cycle. The alarm substance has a more marked effect during daytime, even when the fish are tested in darkness. In the absence of alarm substance, illumination at night does not increase the school-cohesion in such a manner as to make it differ significantly from the normal night dispersion. These observations suggest diurnal fluctuation in the readiness of fishes to school in response to external stimuli. The role played by visual information in enhancing grouping is discussed accordingly. (Authors)

10406. Ziminova, N.A. 1965. COMPOSITION OF SUSPENSIONS FROM THE RYBINSKOE RESERVOIR. (Sostav vzvesei Rybinskogo vodokhranilisha). Tr Inst Biol Vnutr Vod Akad Nauk SSSR 7. 10. 100-111. From: Ref. Zh., Biol., 1966, No. 3D343. (Translation); Biological Abstracts, 48(20): Abst. No. 99743. 1967.

Studies of the composition of suspensions from the Rybinskoe Reservoir were conducted in 1960-61; the suspensions were collected by filtration through membrane filters and by the trap-glass method. The suspensions from the reservoir

are subdivisible into organic (planktonic, bacterial, detrital) and mineral (quartzitic and ferrous). The basic mass of the suspensions consists of particles less than 10 and greater than 1μ in diameter. The level of organic matter in the suspensions varies with the seasons reaching a minimum (15%) during the flood season and a maximum (90%) in winter. The chief source of the suspended organic matter in the reservoir is the plankton; the organic substance brought in from the drainage system make up approximately 1/4 of the total suspended organic matter produced in the reservoir and brought in with the influx. The N level in the suspensions fluctuates seasonally from 0.5 to 3.4%. The trophic value of the suspensions is minimal in winter when they are composed of compounds that are difficult to mineralize.

10407. Aliev, D. S. 1966. RESULTS OF RESEARCH ON THE REARING AND COMMERCIAL UTILIZATION OF HERBIVOROUS FISHES IN TURKMANIA. (Itogi issledovatel'skikh rabot po razvedeniyu i khozyaistvennomu ispol'zovaniyu rastitel'-noyadnykh ryb v Turkmenii). In: Cultivation of herbivorous fishes. Nauka: Moscow. 10-16. From: Ref. Zh., Biol., 1966, No. 81170. (Translation); Biological Abstracts, 48(20): Abst. No. 99746. 1967.

Spawners and offspring of grass and silver carp were kept in ponds (0.4-2.0 ha) and fed with alfalfa, reed and pond weed. At a stocking density of 90-100 specimens per hectare silver carp matured at 2-3 years; at a higher stocking density their growth rate fell off. Grass carp matures at 4-5 years (stocking density nearly 500 specimens/ha). In order to obtain a brood, the spawners were injected with pituitary extract. Best results were obtained in the first half of May. The eggs were incubated in a Weiss apparatus and in net tanks of the Chinese type. Highest mortality occurred in tanks. During the 1963 spawning season, over 1 million larvae of grass and silver carp were obtained.

10408. Bogdanov, M. A. 1966. VARIATION PATTERNS OF THE HIGH-ALTITUDE FRONTAL ZONE AND THE REPRODUCTION OF SOME COMMERCIAL FISHES. (Zakonomernost' izmenchivosti vysochnoi frontal'noi zony i vosproizvodstvo nekotorykh promyslovykh ryb). Tr Vses Nauch-Issled Inst Morsk Ryb Khoz Okeanogr 60: 41-47. From: Ref. Zh., Biol., 1967, No. 21221. (Translation); Biological Abstracts, 48(20): Abst. No. 99750. 1967.

The air masses of the northern and temperate latitudes are bounded by the high-altitude frontal zone which lies between latitudes 40° and 60° N and surrounds the polar region by ring-shaped or elliptical formations. The high-altitude zone shifts gradually, its center moving clockwise around the earth's North Pole. Thus, when the zone occupies its southernmost position over the Pacific, its northernmost position is over the Atlantic. In accordance with the frontal zone, changes occur in the intensity and velocity of the prevailing winds, in the amount of precipitation and in other atmospheric phenomena. These, in turn, are regularly followed by changes in hydrological conditions. For example, a displacement of the frontal zone to the north causes the Kuroshio Current to deviate from the coast of Japan, with the cold Oyashio Current and abyssal waters spreading over the coastal zone. The reproductive conditions of the valuable commercial fish Seriola quinqueradiata become disrupted and its catches decline within 3 to 4 years. A number of other relationships have been found between the position of the high altitude frontal zone and the abundance of commercial fishes (Kamchatka sockeye, North-American humpback, Baikal omul).

10409. Charyev, R., and D. S. Aliev. 1966. EXPERIMENTS ON THE UTILIZATION OF GRASS CARP FOR THE CONTROL OF WATER WEEDS IN CARP REARING PONDS. (Opyt ispol'zovaniya belogo amura dlya bor'by s zarastaniem prudov pri vyrashchivani sazan). In: Cultivation of herbivorous fishes. Nauka: Moscow. 77-82. 1966. From: Ref. Zh., Biol., 1966, No. 81176. (Translation); Biological Abstracts, 48(20): Abst. No. 99753. 1967.

The experiments were conducted in 1962-63 at the Karanet-Niyaz experimental station. In 1962 the pond was used for rearing purposes; it was fertilized, but the fish were not given supplementary food. In 1963 underyearling carp were grown

there; the pond was fertilized, and the fish were fed. The macroflora was represented by filamentary and perfoliate pondweed and reeds. Stocking density of grass carp was 86 and 36 specimens/ha. The summer foraging period of the grass carp (from July 2) was economically more effective than the previous foraging period (from June 16).

10410. Korneeva, L.A. 1966. EFFECT OF NUTRITIONAL TERRAMYCIN ON THE GROWTH AND CHEMICAL COMPOSITION OF 2-SUMMER CARP IN RELATION TO THE QUALITY OF THE DIET. (Vliyanie kormovogo terramitsina na vesovoi rost i khimicheskii sostav dvukhletnego karpa v zavisimosti ot kachestva ratsiona). In: Report Summaries of the All-Union Conference on the Ecology and Physiology of Fishes, 1966. Moscow. 73-74. From: Ref. Zh., Biol., 1967, No. 21112. (Translation); Biological Abstracts, 48(20): Abst. No. 99766. 1967.

Terramycin was added to a purely vegetable and also to a mixed diet in a dose of 2,500, 5,000 and 10,000 units/kg of feed. Growth stimulation was observed in all cases. Muscle raw protein rose. The amount of bound amino acids remained unchanged; a significant fluctuation in the levels of free amino acids was noted, particularly in fish fed a mixed diet.

10411. Myhre, Richard J. (Inst. Pac. Halibut Comm., Seattle, Wash.). 1967. MORTALITY ESTIMATES FROM TAGGING EXPERIMENTS ON PACIFIC HALIBUT. Rep. Inst. Pacific Halibut Comm., 42. 5-43. Illus. Map; Biological Abstracts, 48(20): Abst. No. 99775. 1967.

Sixty halibut tagging experiments conducted between 1925 and 1955 from Cape Scott, Vancouver Island, to Shumagin Islands, Alaska, were used to estimate fishing and total mortality for fully-recruited fish by the method of Gulland (1963). The slope of the regression line relating corresponding estimates of total and fishing mortality was found to be 1.12 which was not statistically different from the expected unit slope. The same relationship provided an estimate of 0.31 for all components of total mortality other than fishing. Similar results were obtained when the same analysis was conducted with Area 2 and Area 3 experiments separately. Comparisons of catchabilities for halibut of different size at tagging indicated that halibut less than 100 centimeters long at tagging in Area 2 have a higher capability than do the larger fish in that area and also higher than either large or small fish tagged in Area 3. Catchabilities for halibut tagged in British Columbia waters were higher than for those tagged to the north and west. Part of this difference may be due to the smaller average size of halibut in British Columbia waters. Catchability estimates for part of Area 2 lying between Vancouver Island and Dixon Entrance in British Columbia were tested for differences between 3 successive 10-year periods beginning with 1925. No evidence of a temporal change in catchability was found for this region. Area 3 experiments yield level, it is concluded that either the fishing mortality estimates lack comparability or the halibut of the 2 areas have different levels of productivity or both. The variance and standard deviation of the total mortality estimates were related to the number of fish tagged. From the shape of this relationship it was concluded that a tagged sample of about 300 fish would usually produce estimates with acceptable variance. A larger sample size probably would not produce as much information as if the additional tagging effort was used in a new experiment at a different location. (Auth.)

10412. North Pacific Division Corps of Engineers, U.S. Army. 1966. 3RD PROGRESS REPORT ON FISHERIES ENGINEERING RESEARCH PROGRAM. 124 p. Illus. North Pacific Division Corps of Engineers, U.S. Army: Portland, Oreg.; Biological Abstracts, 48(20): Abst. No. 99779. 1967.

The construction of dams on the major water courses of the Pacific Northwest presents complex problems in the maintenance of salmon and steelhead resources. Since these anadromous fish must have access to the sea and to their spawning grounds in the rivers and streams in order to complete their life cycle and perpetuate their kind, the survival of this important national resource depends on the installation of efficient passage devices at water development projects. Substantial sums of money were expended on fish facilities at Bonneville Dam in the 1930's

with little basic information on fish passage requirements to guide the designers. In 1951, with McNary Dam under construction and many other projects in the planning stage, the Corps of Engineers initiated its Fisheries-Engineering Research Program to secure engineering and biological information that would enable it to design, construct and operate anadromous fish facilities economically and efficiently. Program Research has been summarized in two previous reports entitled: "Progress Report on Fisheries-Engineering Research Program", Nov., 1956 (out of print) and July, 1960. This report is the 3rd in this series and covers essential Corps of Engineers program research conducted from 1960 through 1965.

10413. Pruter, A.T. (Bur. Comm. Fish. Explor. Fish. and Gear Res. Base, Seattle, Wash.). 1966. COMMERCIAL FISHERIES OF THE COLUMBIA RIVER AND ADJACENT OCEAN WATERS. Fish. Ind. Res., 3(3): 17-66. Illus. Map; Biological Abstracts, 48(20): Abst. No. 99789. 1967.

Fisheries in the Columbia River and the adjacent ocean waters constitute a large and valuable industry with important economic and recreational benefits to people of the Pacific Northwest. Rapidly developing agricultural and manufacturing industries in the Columbia River Basin, however, are placing increasing demands upon the fresh-water environment of resident and anadromous species. The advent of the nuclear age raises the possibility that man may adversely affect the ocean environment also. This report examines the commercial fisheries in the river and ocean, stressing their importance in the overall development plans for the Columbia River Basin. The fisheries are classified into 3 groups: those for species resident in the Columbia, those for anadromous species, and those for marine species. The fisheries then are described on the basis of individual fish species within each of these groups. The descriptions include information on areas of capture, references to types of harvesting gear, and historical reviews of landings. (Auth.)

10414. Vinogradov, V.K., L.V. Erokhina, G.I. Savin, and A.G. Konradt. 1966. METHODS OF ARTIFICIAL BREEDING OF HERBIVOROUS FISHES. (O metodakh iskusstvennogo razvedeniya rastitel' noyadnykh ryb). In: Cultivation of herbivorous fishes. Nauka: Moscow. 17-29. From: Ref. Zh., Biol., 1966, No. 81171. (Translation); Biological Abstracts, 48(20): Abst. No. 99805. 1967.

Under pond conditions, eggs of amurs and of silver carp can be obtained only through pituitary injections (fractional injections for females). The eggs are strained off and fertilized by the dry method, or natural spawning is organized, the first method being the more effective. Average fecundity of first-time spawners comprises in grass carp 255,000 eggs, in bighead 288,000 and in silver carp 265,000. In second-time spawners the fecundity is higher. Usually about 90% of the eggs are fertilized. Incubation takes place in Weiss apparatuses. The yield of larvae that transfer to mixed feeding average 20-30%. From the Weiss apparatuses the young fish enter tanks in which they remain until they transfer to mixed feeding. The highest mortality occurs in tanks. After change-over to mixed feeding, the young fish are transferred to nursery ponds. The yield of fingerlings is not less than 50%. Breeding success depends upon the viability of the sexual products, which in turn depends on the time of the pituitary injection. This should be started at a water temperature not lower than 19-20° C for silver carp and grass carp.

10415. Brizinova, P.N., and S.V. Strel'tsova. 1966. EFFECT OF PHOSPHATIDES AND CARBAMIDES ON PROTEIN ASSIMILATION IN THE RAINBOW TROUT. (Vliyaniye fosfatidov k karbamida na usvoenie belkovogo korma raduzhnoi forel'yu). In: Report Summaries of the All-Union Conference on the Ecology and Physiology of fishes, 1966. Moscow. 70-72. From: Ref. Zh., Biol., 1967, No. 21110. (Translation); Biological Abstracts, 48(20): Abst. No. 100357. 1967.

Addition of phosphatides (10%) to the ration of rainbow trout stimulated the fish's growth, increased the rate of protein cleavage into amino acids, and promoted the assimilation of food mixes. Addition of carbamide (10%) raised the digestive rate.

10416. Kandyuk, R.P. 1966. A COMPARATIVE STUDY OF THE ACTIVITY AND THERMOSTABILITY OF DIGESTIVE ENZYMES OF SOME PLANKTOPHAGIC AND BENTHOPHAGIC FISHES OF THE NORTHWESTERN BLACK SEA. (Sравnitel'naya otsenka aktivnosti i termostabil'nosti pishchevaritel'nykh fermentov nekotorykh planktonoyadnykh i bentosoyadnykh ryb severo-zapadnoi chasti Chernogo morya). In: Report Summaries of the All-Union Conference on the Ecology and Physiology of Fishes, 1966. Moscow. 66-67. From: Ref. Zh., Biol., 1967, No. 21107. (Translation); Biological Abstracts, 48(20): Abst. No. 100368. 1967.

The activity of intestinal enzymes is higher in pelagic than in bottom-feeding fishes. Enzymic activity temperature optimum ranges between 35 and 40° C. The highest trypsin activity was found in horse mackerel; the highest alkaline phosphatase and esterase activity, in sprat. Amylase activity in all the species investigated—horse mackerel, sprat, haddock, gobies ("round" and "toad"), flounder, turbot—was low.

10417. Pegel', V.A., V.A. Remorov, and K.A. Eroshenko. 1966. ON THE PRESENCE OF AN INITIAL PHASE OF DIGESTIVE FLUID SECRETION IN FISHES. (K voprosu o nalichii pervoi fazy v sekretsiyi pishchevaritel'nykh sokov u ryb). In: Report Summaries of the All-Union Conference on the Ecology and Physiology of fishes, 1966. Moscow. 64-65. From: Ref. Zh., Biol., 1967, No. 21105. (Translation); Biological Abstracts, 48(20): Abst. No. 100387. 1967.

Evidence is presented concerning the participation of the central nervous system in the digestive processes of fishes. In contrast to higher animals, in fishes the feeding pattern exerts a relatively small effect on digestion and assimilation of food. The fish nervous system stimulates the secretion of digestive fluids, which are discharged spontaneously even in the absence of digestion, thus suppressing the motor function of the intestines and thereby increasing the rate of digestion and assimilation of food. Digestive rate is influenced by the nature of the food itself, a fact indicating the significance of local nervous structures in digestion. All these features resemble the regulation of digestion in the early developmental stages of higher vertebrates.

10418. Shcherbina, M.A., and K.F. Sorvachev. 1966. RESORPTION OF AMINO ACIDS OF ARTIFICIAL FOODS DURING THEIR MOVEMENT THROUGH CARP INTESTINES. (Rezorbtsiya aminokislot iskusstvennykh kormov v protsesse proizvodnii pishchi po kishchniku karpov). In: Report Summaries of the All-Union Conference on the Ecology and Physiology of Fishes, 1966. Moscow. 69-70. From: Ref. Zh., Biol., 1967, No. 21109. (Translation); Biological Abstracts, 48(20): Abst. No. 100394. 1967.

The carp were fed with granulated sunflower and cotton cakes. Absorption of amino acids from both cakes were similar. Arginine, phenylalanine and glutamic acid were absorbed faster than any other amino acids. The largest amounts of arginine and phenylalanine were absorbed in the forward part of the intestines. Lysine was poorly absorbed. Maximum cleavage of protein and maximum absorption of amino acids occurred in 3 forward parts of the intestines.

10419. Mounib, M. Said (Fish Res. Board Can., Halifax Lab., Halifax, N.S., Canada). 1967. METABOLISM OF PYRUVATE, ACETATE AND GLYOXYLATE BY FISH SPERM. Comp. Biochem. Physiol., 20(3): 987-992; Biological Abstracts, 48(20): Abst. No. 100867. 1967.

Evidence has been presented for the reduction of pyruvate to lactate by fish (Salmo salar and Gadus morhua) sperm. In addition pyruvate underwent an oxidative decarboxylation and fixation with carbon dioxide by fish sperm; the role of these reactions is discussed. Acetate was oxidized more rapidly than glyoxylate, and more than the corresponding carbon atoms (i.e. C-2 and C-3) of pyruvate. Sperm with glyoxylate oxidized C-1 in preference to C-2, and this was particularly obvious under anaerobic conditions. An active transaminase system was observed, as indicated by the formation of amino acids from the added substrates. (Auth.)

10420. Sundararaj, Bangalore I., and S. K. Nayyar (Dept. Zool., Univ. Delhi, Delhi, India). 1967. EFFECTS OF EXOGENOUS GONADOTROPHINS AND GONADAL HORMONES ON THE TESTES AND SEMINAL VESICLES OF HYPOPHYSECTOMIZED CATFISH, *Heteropneustes fossilis* (Bloch). Gen. Comp. Endocrinol., 8(3): 403-416; Biological Abstracts, 48(20): Abst. No. 100916. 1967.

Response of regressed testes and seminal vesicles was studied after 30-day treatment with testosterone propionate (TP) or estradiol benzoate (EB) in 136-day hypophysectomized catfish, and with ovine follicle-stimulating hormone (FSH), human chorionic gonadotrophin (HCG), and TP singly or in combination in 337-day hypophysectomized catfish, *Heteropneustes fossilis*. In 136- and 337-day hypophysectomized controls, the testes and seminal vesicles showed complete regression; spermatogenesis in the testes was arrested at the level of spermatogonia and the loculi of the seminal vesicles were atrophic and devoid of secretion. After treatment with various doses of TP, spermatogenesis in the testes and secretory activity in the seminal vesicles were restored. Olive oil or EB treatment induced neither spermatogenesis in testes nor secretory activity in the seminal vesicles. Treatment with FSH did not restore spermatogenesis in the testes or secretory activity in the seminal vesicles, but caused a slight improvement in testicular weights over untreated hypophysectomized controls. On the other hand, after treatment with various doses of HCG, spermatogenesis in the testes and secretory activity in the seminal vesicles resumed. Catfish given FSH plus HCG had testes and seminal vesicles heavier than those given either component alone. Simultaneous treatment with FSH and TP did not induce gravimetric or histological changes in testes and seminal vesicles different from those obtained with TP alone. The above results indicate that while TP or HCG can reinstitute and restore spermatogenesis in the testes and secretory activity in the seminal vesicles of hypophysectomized catfish, FSH singly is virtually ineffective although it can synergize with HCG. The possible mechanisms involved are discussed. (Authors)

10421. Ball, J. N., and D. M. Ensor (Dept. Zool., Sheffield Univ., Sheffield, England). 1967. SPECIFIC ACTION OF PROLACTIN ON PLASMA SODIUM LEVELS IN HYPOPHYSECTOMIZED *Poecilia latipinna* (TELEOSTEI). Gen. Comp. Endocrinol., 8(3): 432-440. Illus.; Biological Abstracts, 48(20): Abst. No. 100924. 1967.

Plasma sodium concentrations in freshwater *Poecilia latipinna* fall by about 25% within 24 hours of removal of the pituitary gland. A single injection of ovine prolactin (0.1 to 1.4 IU per gram weight) 4 hours after hypophysectomy partially or completely prevents this fall in sodium levels, the response being dose-dependent. ACTH (adrenocorticotropin) growth hormone, TSH (thyroid-stimulating hormone) alpha-MSH (melanocyte stimulating hormone), oxytocin, vasopressin, arginine vasotocin and isotocin (each tested at a low and a high dose) were all unable to influence plasma sodium levels in this protocol. In a slightly hypotonic dilute seawater, chronic prolactin therapy maintained normal plasma sodium levels in hypophysectomized fish, but ACTH, growth hormone, TSH and alpha-MSH were ineffective. The gonadotrophins can be excluded from participation in the maintenance of plasma sodium in freshwater *Poecilia*, since natural or experimental alterations in the pituitary-ovary axis have no effect on the ability of the fish to survive in freshwater. Thus the sodium-maintaining property of prolactin is not shared by other pituitary hormones, and this may be taken to indicate a specific physiological function of the teleostean prolactin-like hormone. Plasma concentrations of potassium and calcium did not alter in parallel with sodium, and were not affected by hypophysectomy. (Authors)

10422. Danyulite, G. P., and G. A. Malyukina. 1966. ELECTRIC-FIELD EFFECT ON FISH. (Rezultaty issledovaniy mekhanizma deistviya polya elektricheskogo toka na rybu). In: Report Summaries of the All-Union Conference on the Ecology and Physiology of Fishes, 1966. Moscow. 138-139. From: Ref. Zh., Biol., 1967, No. 21154. (Translation); Biological Abstracts, 48(20): Abst. No. 101227. 1967.

Experiments involving elimination of skin receptors, encephalotomy, severance of the spinal cord and blocking of myoneural transmission showed that the

anodic reaction was brought about by stimulation of dorsal nerve fibers. The latent time effect of the current depends on the fish's orientation in the electric field and is minimal when the fish swims at right angles to the direction of the current. The anodic reaction is mainly due to the electric field's polarizing effect on the autonomic, locomotor apparatus of the spinal cord, which ensures a torso-caudal undulatory motion.

10423. Williams, A. K., and Carl R. Sova (Southeast Water Lab., Dept. of the Interior, Athens, Ga.). 1966. ACETYLCHOLINESTERASE LEVELS IN BRAINS OF FISHES FROM POLLUTED WATERS. *Bull. Environ. Contam. Toxicol.*, 1(5): 198-204; *Biological Abstracts*, 48(20): Abst. No. 101384. 1967.

Distressed menhaden collected from the Ashley River, South Carolina, were found to have 46.8 percent less acetylcholinesterase (AChE) activity in brain homogenates as compared to menhaden collected from offshore waters. Menhaden and croakers also taken from the Ashley River, but not in a distressed condition, were found to be 16.5 and 35.8 percent inhibited, respectively. AChE inhibiting materials were found in 3 of 12 waste water samples collected from the vicinity of the Ashley River. (Authors)

10424. Parvatheswararao, V. (Dept. Zool., Sri Venkateswara Univ., Tirupati, India). 1967. SOME MECHANISMS UNDERLYING THERMAL ACCLIMATION IN A FRESHWATER FISH, *Etropoplus maculatus* (TELEOSTEI). *Comp. Biochem. Physiol.*, 21(3): 619-626. *Illus.*; *Biological Abstracts*, 48(20): Abst. No. 101774. 1967.

Water content increased on warm acclimation in the brain, liver and muscle by 4.6, 8 and 3 %, respectively; it decreased on cold acclimation by 2.3 and 0.6 % in the brain and liver but increased by 1.9 % in the muscle. Osmotic pressure of tissue fluid remained almost constant at 0.45 % NaCl equivalent despite thermal acclimation. On cold (20° C) acclimation K increased by 12 % and Ac by 95 %, while Na and Mg decreased by 10 % each, Cl by 49 % and free amino acids by 28 %. On warm (35° C) acclimation Mg increased by 8 %, Ca by 10 %; Na decreased by 16 %, K by 8 % and Cl by 40 %. A slight decrease in free amino acids by 13 % was also noticed. Ascorbic acid increased by 89 % on cold acclimation and decreased by 28 % on warm acclimation. The possible significance of these changes in the metabolic compensation to thermal stress is discussed. (Auth.)

10425. Roberts, John L. (Dept. Zool., Univ. Mass., Amherst, Mass.). 1966. SYSTEMIC VERSUS CELLULAR ACCLIMATION TO TEMPERATURE BY POIKILO-THERMS. In: 2nd International Symposium on Quantitative Biology of Metabolism, Helgoland, Ger., 21-24 Sept. 1965. *Helgolander Wiss Meeresuntersuch.*, 14(1/4): 451-465. *Illus.* (Ger. summ.); *Biological Abstracts*, 48(20): Abst. No. 101775. 1967.

Systemic dominance in homeostasis was considered in relation to metabolic compensations in the respiration of the sunfish, *Lepomis gibbosus*, the crucian carp, *Carassius carassius*, and selected tissues (brain, gill, muscle) following adaptation to various temperatures and photoperiods. Uncoupled respiration was examined in sunfish brain and gill tissues following treatment with 2,4-dinitrophenol. Comparisons were made (at 20° C) between day and night respiration rates of crucian carp acclimated to 5°, 12° and 20° C. These suggest that the inverse compensation of the fish is a behavioral adaptation to special winter conditions, perhaps hibernation. Some of the problems concerned with deriving ecological meaning from experiments on resistance and capacity adaptations in isolated cells and tissues were discussed. The suggestion is made that means be developed to expand studies in which adaptation characteristics of cell types can be examined within living animals. (From auth.)

10426. Wright, Samuel G. 1968. THE ORIGIN AND MIGRATION OF WASHINGTON'S CHINOOK AND COHO SALMON. Washington Dept. of Fisheries Information Booklet No. 1. 25 p.

10427. Ivanov, V.N. 1966. THE ACTION OF RADIOACTIVE SUBSTANCES ON THE EMBRYONIC DEVELOPMENT OF MARINE FISHES. (Deistvie radioaktivnykh veshchestv na embrional'noe razvitie morskikh ryb). In: Abstracts of reports to the 2nd International Oceanographic Conference, 1966. Nauka: Moscow. 174-175. From: Ref. Zh., Biol., 1966, No. 12M90. (Translation); Biological Abstracts, 48(20): Abst. No. 102141. 1967.

Developing fish eggs with the highest buildup factor accumulate yttrium-90, yttrium-91, and cerium-144; there are smaller accumulations of strontium-89, strontium-90, ruthenium-106, and cesium-137. While most of the yttrium, cerium, and ruthenium accumulate in the egg membranes (the buildup factor is 10^4), strontium and cesium are localized mostly in embryonic tissue. Exceeding the optimal incubation temperature causes intensification of the radiobiological effect, while a drop in temperature leads to inhibition of the radiation reaction. Thus, radioactivity of the eggs in itself creates a source of elevated dosages of ionizing radiation. Because of this the damaging action begins to be manifested at increasingly lower levels of contamination of the water.

10428. Leczyk, Mieczyslaw. (Dept. Comp. Anat., Inst. Zool., Wroclaw Univ., Breslau, Poland). 1965. EFFECT OF TEMPERATURE ON THE RATE OF EMBRYONIC DEVELOPMENT OF Esox lucius. Zool. Pol., 15(2): 101-110. (Pol. and Russ. summ.); Biological Abstracts, 48(20): Abst. No. 102144. 1967.

Observations were carried out for 3 years proving that the longest period of embryonic development in this species coincides with the mean temperature of about 8° C (optimal temperature). Above and below this point the number of day-degrees which elapse between fertilization and mass hatching decreases, being one half lower at 18.5° C than at the optimal temperature. Action of an enzyme upon the egg membrane is suggested. --Courtesy NSF (PL 83-480) 1967.

10429. Romanov, N.S. 1966. ANNOTATED BIBLIOGRAPHY ON FAR EASTERN AQUATIC FAUNA, FLORA AND FISHERIES. 391 p. Israel Program for Scientific Translations: Jerusalem. Pr. \$7.00; Biological Abstracts, 48(21): Abst. No. 104361. 1967.

This bibliography, compiled by the author contains names of about 3,700 works, accompanied by short annotations. More than three quarters (2,931) are works on fishes and fisheries. These are followed by works on mammals (433), invertebrates (209), and algae (117). According to the nature of these works, the bibliography is divided into four sections: fishes and fisheries; sea mammals and hunting; sources and utilization of invertebrates; and sources and utilization of marine algae. There are subject and author indices, and an index of the sources utilized.

10430. Nenashev, G.A. (Res. Inst. Lake River Fish., Leningrad, USSR). 1966. DETERMINATION OF HERITABILITY OF DIFFERENT CHARACTERS IN FISHES. (Opredelenie nasleduemosti razlichnykh priznakov u ryb). Genetika, 11. 100-108. Illus. (Engl. summ.); Biological Abstracts, 48(21): Abst. No. 104568. 1967.

The determination of the heritability of a number of economically important and diagnostic characters in the Ropsha carps was studied by 2 different methods: the analysis of regression of the offsprings on the male parents; the analysis of variance of families of half-sibs and full sibs. The method of regression, being applied to fishes, does not provide sufficiently accurate results if the numbers of individuals in each progeny are small. The method of analysis of variance provides more accurate results. The value of the heritability of different characters varies within the range of 0.2 to 0.7. The characters having a comparatively low heritability are: the body weight and length (0.2 to 0.4); the exterior indexes 1/H and H/B (0.3 to 0.5) and the number of scales in the lateral lines (0.25 to 0.50). The characters with a relatively high heritability are: the total number of vertebrae and their number within the body section (0.5 to 0.7); the number of gill rakers, the probable value of the heritability of which is 0.7 to 0.9. Certain requirements or methods of determining heritability in fishes are formulated. (From auth. summ.)

10431. McPhail, J.D. (Coll. Fish., Univ. Wash., Seattle, Wash.). 1967. DISTRIBUTION OF FRESHWATER FISHES IN WESTERN WASHINGTON. Northwest Sci., 41(1): 1-11. Maps; Biological Abstracts, 48(21): Abst. No. 104988. 1967.

10432. Yudin, V.L. 1966. FISH CULTURE IN UZBEKISTAN RICE FIELDS. (Rybovodstvo na risovykh polyakh Uzbekistana). In: Biological bases of Central Asian and Kazakhstan fisheries. Nauka: Alma-Ata. 271-273. From: Ref. Zh., Biol., 1967, No. 31144. (Translation); Biological Abstracts, 48(21): Abst. No. 105025. 1967.

The fields produce 73.7 kg/ha of carp after 1 year, and 100 kg/ha after 2 years; with a mixed stocking of fry and yearlings the crop is nearly 80 kg/ha. It is concluded that the combined culture of rice and carp faces dubious prospects. In fallow rice fields with a 2-year turnover of rice, a 1-year turnover of cultivated crops and a 2-year turnover of fish, the crop of fish was 70-100 kg/ha depending on the stocking rate.

10433. Ackman, R.G. (Halifax Lab., Fish. Res. Board Can., Halifax, N.S., Canada). 1967. FATTY ACIDS OF COHO SALMON FINGERLINGS. Amer. Oil Chem. Soc. J., 44(6): 372; Biological Abstracts, 48(21): Abst. No. 105521. 1967.

10434. Sterling, Julian A., David R. Meranze, Seymour Winsten, and Myles K. Krieger. 1967. OBSERVATIONS OF LAMPREY LIVER DURING ITS LIFE CYCLE. J. Albert Einstein Med. Center, 15(1): 107-116. Illus.; Biological Abstracts, 48(21): Abst. No. 105618. 1967.

Blood and liver enzymes, gross and histological liver anatomy were studied in the lamprey (*Petromyzon marinus*) during its life cycle. Specimens were obtained from the Great Lakes and the Delaware River Watershed. Standard methods were used for study of gross and histological anatomy, as well as for measurement of serum and tissue enzyme content, in more than 100 specimens. The brown liver in the lamprey larva has bile ducts and some measurable liver tissue enzymes. The liver becomes green in the parasitic and spawning lamprey, at which stages it is without bile ducts and has qualitative increases in bilirubin and liver tissue enzymes. These findings indicate the need for continuing investigation of embryologic and developmental changes, as well as environment (including nutritional) influences, endocrine and other factors with possible relation to biliary atresia as it is found in human infants. (Authors)

10435. Sycheva, V.N. (Ukr. Fish. Res. Inst., Kiev, USSR). 1965. SEX GLAND REACTION IN PIKE *Esox lucius* L. TO A CHANGE IN THE ECOLOGIC ENVIRONMENT. (Reaktsiya polovoykh zhelez shchuki *Esox lucius* L. na izmenenie ekologicheskikh uslovii). Vop Ikhtiol., 5(2): 296-301. Illus.; Biological Abstracts, 48(21): Abst. No. 106030. 1967.

Histologic examination (precedure given) of 113 ovaries and 32 spermaries from 4-10 year old fish taken during spring, summer or fall of 1959-1961 in the Kakhovskoe Reservoir, where the pike catch decreased from 38.4% of total for 1958 to 4.8% for 1961, disclosed that the modified environment in the reservoir (i.e. fluctuating water level, irregular temperature of water, etc.) produced disruptions in the timing of gonadal maturing stages and the ensuing decrease in fertility. Partial deposition of roe was noted despite the lack of favorable spawning grounds where favorable temperatures prevailed. Roe retained in ovaries was subject to complex and prolonged resorption processes. This delayed the development of new oocytes and, in consequence, caused disruptions in the timing of individual developmental stages. Well pronounced asynchronization of oocyte development during vitellogenesis equalized as the ovaries entered stage IV. Gonads in some females attained only stages II, III or III-IV by spring due to resorption as noted above and such females failed to spawn, their immature oocytes maturing in some cases by fall and then being resorbed. Spermaries were not subject to noticeable changes. --B. Le Bental.

10436. Rayner, M. D., and M. J. Keenan (Pacific Biomed. Res. Center, Univ. Hawaii, Hawaii). 1967. ROLE OF RED AND WHITE MUSCLES IN THE SWIMMING OF THE SKIPJACK TUNA. *Nature*, 214(5086): 392-393. Illus.; Biological Abstracts, 48(21): Abst. No. 106169. 1967.

The preliminary results of recordings from some 40 fish indicated that the deep red muscle (drmm), showed electrical activity in almost all cases in which any swimming movements could be seen. The size of the extracellularly recorded spikes, their frequency and the duration of bursts of activity could be clearly correlated with the amplitude, frequency and form of the observed swimming movements. During low frequency swimming movements, some electrical activity was also commonly observed in the lateral superficial muscle (lsm). In the 3 fish investigated in which the deep red muscle was electrically silent during low frequency swimming, large spikes were observed in the lateral superficial muscle. No electrical activity could usually be demonstrated in white muscle regions during low frequency swimming movements. These regions showed increasing activity at the higher tail beat frequencies in the tranquillized fish; they also showed activity after tactile stimulation of the head and operculum. In this latter situation, white muscle activity sometimes occurred with tail beats of low frequency and large amplitude. White muscle activity was not normally found in fish treated with pentobarbital, even after strong tactile stimulation. When spontaneous high frequency swimming occurred, it was mediated entirely by increased red muscle activity. (From auth.)

10437. Cole, H., D. Barry, D. E. H. Frear, and A. Bradford (Dept. Plant Pathol. and Entomol., Pa. State Univ., University Park, Pa.). 1967. DDT LEVELS IN FISH, STREAMS, STREAM SEDIMENTS, AND SOIL BEFORE AND AFTER DDT AERIAL SPRAY APPLICATION FOR FALL CANKERWORM IN NORTHERN PENNSYLVANIA. [*Alsophila pometaria*, *Salvelinus fontinalis*, *Catostomus commersoni*] Bull. Environ. Contam. Toxicol., 2(3): 127-146; Biological Abstracts, 48(21): Abst. No. 107161. 1967.

10438. Holland, H. Tom, David L. Coppage, and Philip A. Butler (U. S. Army Corp Eng., St. Louis, Mo.). 1967. USE OF FISH BRAIN ACETYLCHOLINESTERASE TO MONITOR POLLUTION BY ORGANOPHOSPHORUS PESTICIDES. Bull. Environ. Contam. Toxicol., 2(3): 156-162; Biological Abstracts, 48(21): Abst. No. 107169. 1967.

10439. Lowe, Jack I. (U. S. Bur. Comm. Fish. Biol. Lab., Gulf Breeze, Fla.). 1967. EFFECTS OF PROLONGED EXPOSURE TO SEVIN ON AN ESTUARINE FISH, *Leiostomus xanthurus* Lacepede. Bull. Environ. Contam. Toxicol., 2(3): 147-155; Biological Abstracts, 48(21): Abst. No. 107179. 1967.

10440. Honma, Yoshiharu, and Yoshitsugu Hirosaki (Fac. Sci., Niigata Univ., Niigata, Japan). 1966. HISTO-PATHOLOGY ON THE TUMORS AND ENDOCRINE GLANDS OF THE IMMATURE CHUM SALMON, *Oncorhynchus keta*, REARED IN THE ENOSHIMA AQUARIUM. Jap. J. Ichthyol., 14(1/3): 74-83. Illus. (In Jap. with Engl. summ.); Biological Abstracts, 48(21): Abst. No. 107373. 1967.

A macroscopical and histological description of the tumors and endocrine glands of 2 individuals of immature chum salmon, *Oncorhynchus keta* (Walbaum), is given, which were obtained in the course of breeding experiment. The salmon eggs inseminated on November 22, 1959 in the Chitose River, Hokkaido, were transported by air to the Enoshima Aquarium, and reared with cold sea-water until most of the fish died of various kinds of diseases and accidents. The proximal pars distalis of the hypophysis of both specimens (A and B) is composed chiefly of acidophils, and the basophils (cyanophils) which seem to be the gonad stimulating cells are meager in number. There was no indication of the yolk formation (vitellogenesis) in the majority of ovarian eggs. The secretory phase of the hypothalamic neurosecretory cells was in a state of low activity, and the amount of neurosecretory substance stored into the neurohypophysis was small. The thyroid gland was in a state of hypofunction and the normal appearance of the

corpuscles of Stannius was detected. In the B-specimen the normal feature of the adrenal cortical tissue was seen. There was a swelling in the head kidney of the A-specimen. This tumorous development was composed of many lymphocytes derived from parenchymatous cells, curled collagenous fibers and reticulum. In several places the tumorous tissues were collapsed due to the necrosis and were changed into serous or lacteal substance. A large tumorous growth was also found in the right side of posterior part of the B-specimen. Just beneath the lateral line of the fish, a severe ulcer due to the degeneration and necrosis of the growth is produced. The inside of the growth was seen. This tumor is a small round-cell sarcoma in the inter-trunk-muscular connective tissue. (Authors)

10441. Lotlikar, Prabhakar D., Elizabeth C. Miller, James A. Miller, and John E. Halver. 1967. METABOLISM OF THE CARCINOGEN 2-ACETYLAMINO-FLUORENE BY RAINBOW TROUT. *Proc. Soc. Exp. Biol. Med.*, 124(1): 160-163.

Administration of the carcinogen 2-acetylaminofluorene (AAF) orally or by injection into rainbow trout resulted in the excretion of 5- and 7-hydroxy-AAF in the urine and feces. These metabolites were also formed *in vitro* from AAF by trout liver homogenates or the microsomal fraction in the presence of TPNH or a TPNH-generating system. N-Hydroxylation of AAF was not demonstrated either *in vivo* or *in vitro*. (Authors)

10442. Walliker, D. 1968. STUDIES ON Myxidium oviforme, A MYXOSPORIDAN PARASITE OF IRISH SALMON, Salmo salar. *Parasitology*, 58(Pt. 4): 839-844.

Myxidium oviforme is described from Irish salmon Salmo salar. Its close relationship with M. folium, M. moxostomatis and M. aploidinoti, and its possible economic importance are discussed. Attempts to establish infections of M. oviforme in young, parasite-free salmon are described, and the reasons for their negative results discussed. (Auth. summ.)

10443. Lyford, John H., Jr., and Harry K. Phinney (General Sci. Dept., Oregon Univ., Corvallis, Oreg.). 1968. PRIMARY PRODUCTIVITY AND COMMUNITY STRUCTURE OF AN ESTUARINE IMPOUNDMENT. *Ecology*, 49(5): 854-866.

An impoundment was constructed for the purpose of raising anadromous fish to smolting size so that eventually their return for spawning would improve the sports fishery of the river and estuary system. This impounded estuary was employed to study primary productivity, community respiration, and community structure as they related to seasonal and temporal succession, salinity, and water temperature. Metabolism of plankton was studied by the light- and dark-bottle technique; that of the benthic community was determined by using the "diurnal oxygen curve" method. Four different physical environments developed owing to procedures required to control the water in the management of the impoundment. One environment was saline, two were brackish, and one was fresh water. Distinct benthic plant communities developed in each of these environments, and these communities were named according to the dominant plants. An Enteromorpha-Melosira community developed in the saline environment and accounted for the highest metabolic rates of the entire study. A photosynthesis to respiration (P/R) ratio of 1.36 resulted in the development of a large standing crop which dramatically became senescent during late fall and formed organic ooze on the bottom as well as contributing dissolved and suspended organic matter in the water. The Melosira-Enteromorpha community developed in brackish water and maintained a P/R of 0.76. The Melosira-Spirogyra community developed in the fresh-water environment and maintained a P/R of 0.78, and the Rhizoclonium-Melosira-Synedra community, which developed in brackish water, maintained a P/R of 0.77. The plankton flora was characteristically tychoplankton. The magnitude of the plankton metabolic rates was less than that of the benthic communities. The impoundment maintained a mean P/R of 1.02 over the entire study period, and was essentially autotrophic, primarily owing to the large standing crop developed by the Enteromorpha-Melosira community. Little exogenous organic material appeared to have been imported into the system. (Authors)

10444. Allen, George H. (Fisheries, Div. of Natural Resources, Humboldt State College, Arcata, Calif.). 1968. MORTALITY OF COHO SMOLTS MIGRATING THROUGH A LAKE SYSTEM. *Ecology*, 49(5): 1001-1002.

To study mortality of smolts migrating through a lake and river system, single fin-marked fingerling coho salmon (*Oncorhynchus kisutch*) of the 1950 brood year were released in 1952 at two points within the Lake Washington drainage, Puget Sound, Washington. Coho smolts migrating through 56 km of lake and river system before entering Puget Sound suffered about 22% greater mortality than coho migrating only 8 km (5 miles). Factors possibly biasing the result were assessed for the experiment, especially the need for equal fishing and natural mortality on test lots of fish while in the ocean. (Auth.)

10445. Eales, J. Geoffrey (Zool. Dept., Univ. of Manitoba, Winnipeg, Manitoba, Canada). 1968. THE EEL FISHERIES OF EASTERN CANADA. Fisheries Research Board of Canada Bulletin 166. 79 p. Illus.

During the summers of 1965 and 1966, a survey of eel fishing in Canada was conducted. The objectives of this survey were to assess the current exploitation of eels and to describe the various methods of capturing them. This bulletin presents the results of the survey together with other information of potential value to anyone interested in fishing for this largely neglected species.

10446. Trent, Lee, and William W. Hassler (Dept. of Zoology, North Carolina State Univ., Raleigh, N. C.). 1968. GILL NET SELECTION, MIGRATION, SIZE AND AGE COMPOSITION, SEX RATIO, HARVEST EFFICIENCY, AND MANAGEMENT OF STRIPED BASS IN THE ROANOKE RIVER, NORTH CAROLINA. *Chesapeake Sci.*, 9(4): 217-232.

This study is based on about 5,000 striped bass collected from the Roanoke River in the springs of 1963, 1964, and 1965. The relation between gill net mesh size and the mean length of male striped bass caught is linear and is described by $Y = 3.41X + 2.24$ inches where Y = fork length in inches and X = stretched mesh size in inches. The girth-length relation for each sex is linear, and there is no significant difference between sexes. It is described by $Y = 0.67X - 1.12$ inches, where Y = gill girth in inches and X = fork length in inches. Most males migrated upstream through Williamston between March 26 and April 20; most females migrated through between April 16 and May 12. Dominant age groups were III and IV for the males and IV and V for the females. Estimates of the mean fork lengths are: Males; III—16.7 inches and IV—18.3 inches. Females; IV—20.2 inches and V—21.4 inches. Estimates of sex ratios from striped bass caught in gill nets in 1963-65 were 69.7%, 85.1%, and 76.9% males. The accuracy of these estimates is unknown. The large differences in the sex ratio estimates between years probably resulted from variation in recruitment into the Roanoke River population each year. The management techniques which are most feasible for increasing the value of the sport and commercial striped bass fisheries in North Carolina appear to be (1) increasing the minimum size limit from 12 inches total length to 16 inches fork length and (2) enforcing regulations which restrict the use of gill nets having mesh sizes under 4.75 inches stretched mesh. (Authors)

10447. Dovel, William L. (Natural Resources Inst. Univ. of Maryland, Solomons, Md.). 1968. PREDATION BY STRIPED BASS AS A POSSIBLE INFLUENCE ON POPULATION SIZE OF THE ATLANTIC CROAKER. *Trans. Amer. Fish. Soc.*, 97(4): 313-319.

Recent data collected from the upper Chesapeake Bay, Maryland, and a review of commercial fishery statistics suggests that predation by striped bass on post larvae and juveniles of the Atlantic croaker, during periods of low water temperatures, may be a significant factor influencing the recent decline of the croaker on the northeastern coast of North America. The life history of the croaker, stomach analysis of adult striped bass, and commercial fishery statistics for both species during the period 1930-1965 are discussed in this connection. (Auth.)

10448. Clark, John (Bur. of Sport Fisheries and Wildlife, Sandy Hook Marine Lab., Highlands, N. J.). 1968. SEASONAL MOVEMENTS OF STRIPED BASS CONTINGENTS OF LONG ISLAND SOUND AND THE NEW YORK BIGHT. Trans. Amer. Fish. Soc., 97(4): 320-343.

Recaptures of striped bass, *Morone saxatilis*, tagged along the northeast Atlantic coast of the United States from 1959 to 1963 gave evidence of varied patterns of seasonal movement of the species. From analysis of distribution patterns of 498 recaptured fish, it is shown that distinguishable contingents of striped bass seasonally inhabit Long Island Sound and coastal waters of the New York Bight. Three groups that appeared to be of Hudson River origin were the Hudson Estuary, Hudson-Atlantic, and Hudson-West Sound Contingents. The origin of a fourth group, the Long Island Sound Contingent, was not evident. Other contingents, of southern or undetermined origin, also appeared in the area from spring to fall. The Hudson River is shown to be a major spawning river and source of recruitment of striped bass populations of Long Island Sound and the New York Bight. (Auth.)

10449. Lewis, Robert M., and William F. Hettler, Jr. (Bur. of Commercial Fisheries, Biological Lab., Beaufort, N. C.). 1968. EFFECT OF TEMPERATURE AND SALINITY ON THE SURVIVAL OF YOUNG ATLANTIC MENHADEN, *Brevoortia tyrannus*. Trans. Amer. Fish. Soc., 97(4): 344-349.

Survival of young Atlantic menhaden at different salinities and temperatures was studied in the laboratory. Fish were tested in the spring, summer, and early fall at high temperatures (25° to 36° C) and low (5° to 7‰), intermediate (15‰), and high salinities (31 to 34‰). In the late fall and early winter, tests were conducted at temperatures of 3° to 7° C and salinities of 10 and 26 to 30‰. Temperature had the greatest effect on survival; acclimation time also affected survival but to a lesser degree. Salinity did not appear to markedly affect survival time at the temperatures studied. Yearlings were more sensitive to high temperatures than were younger fish. (Authors)

10450. Islam, Bhuiyan N., and G. B. Talbot (Dept. of Entomology, East Pakistan Agricultural Univ., Mymensingh, East Pakistan). 1968. FLUVIAL MIGRATION, SPAWNING, AND FECUNDITY OF INDUS RIVER HILSA, *Hilsa ilisha*. Trans. Amer. Fish. Soc., 97(4): 350-355.

Hilsa is a widely distributed anadromous fish occurring from the Persian Gulf to South Vietnam. The Indus is the only river in West Pakistan which supports a run of hilsa. These fish enter the Indus River each year, beginning about the middle of January, and in some years remain in the river as late as November. The bulk of hilsa, however, are found during June, July, and early August. Although increased stream flow does not appear to be the stimulus that attracts hilsa into the Indus, as reported for other streams, the peak of the run does occur during peak flows. Maturing hilsa entering the river range between 25 and 60 cm in length while a few immature fish enter that are as small as 22 cm. Most of the male fish appear to be in their 4th year of life, while the females are represented predominately by two age classes that appear to be their 4th and 5th, respectively. Fecundity of hilsa varies between 755,000 and 2,917,000 eggs per female. There is no close correlation between length or weight and fecundity. (Authors)

10451. Raymond, Howard L. (Bur. of Commercial Fisheries, 2725 Montlake Blvd. East, Seattle, Wash.). 1968. MIGRATION RATES OF YEARLING CHINOOK SALMON IN RELATION TO FLOWS AND IMPOUNDMENTS IN THE COLUMBIA AND SNAKE RIVERS. Trans. Amer. Fish. Soc., 97(4): 356-359.

Migration rates of yearling chinook salmon (*Oncorhynchus tshawytscha*) through free-flowing and impounded stretches of the Snake and Columbia Rivers were compared during periods of low and moderate river discharge. Generally, the rate of migration was directly related to the water flows; it was 21 km/day at the low river discharge (Columbia - 4,248 m³/sec; Snake - 1,416 m³/sec), and 37 km/day during moderate river discharge (Columbia - 8,495 m³/sec; Snake - 2,265 m³/sec). Migration rates through most free-flowing and impounded stretches of the Snake and

Columbia Rivers were similar with the one exception that in McNary Reservoir (Columbia River) fish moved only about one-third as fast as elsewhere. Marked yearling chinook salmon from the Salmon River took 32 days to travel the 669 km to Bonneville Dam during the low river discharge in 1966. New impoundments may more than double the travel time now required during low river flows. (Auth.)

10452. Bjornn, T. C., D.R. Carddock, and D.R. Corley (Idaho Coop. Fishery Unit, Univ. of Idaho, Moscow, Ida.). 1968. MIGRATION AND SURVIVAL OF REDFISH LAKE, IDAHO, SOCKEYE SALMON, Oncorhynchus nerka. Trans. Amer. Fish. Soc., 97(4): 360-373.

Most adult sockeye salmon returning to Redfish Lake had spent two years in the ocean. Survival from smolt to returning adult at the lake ranged from 0.14 to 1.83%. The sex-ratio was nearly even. Survival of sockeye in the lake from potential egg deposition to smolt migration was usually less than 6%. In at least one year, smolts originating from kokanee and/or residual sockeye may have comprised a large proportion of the migration. There was little relationship between egg deposition and smolts produced. Sockeye salmon smolts migrated from Redfish Lake primarily from 1800 to 2400 hours. There was no consistent relationship between seasonal timing of the migration, lake ice cover, temperatures or flow of the outlet stream. The role of photoperiod in timing of the migration and the parr-smolt transformation is unclear. Growth of juvenile sockeye in the lake was inversely related to population density and age at migration was dependent upon first year growth in the lake. More than half the fish of a year class migrated as yearlings when their mean length was more than 85 mm. When the mean length of yearlings was less than 85 mm less than half the fish of a year class migrated as yearlings. (Authors)

10453. Wagner, Harry H. (Oregon State Game Comm., Res. Div., Oregon State Univ., Corvallis, Oreg.). 1968. EFFECT OF STOCKING TIME ON SURVIVAL OF STEELHEAD TROUT, Salmo gairdnerii, IN OREGON. Trans. Amer. Fish. Soc., 97(4): 374-379.

Marked juvenile steelhead trout were stocked from 1961 through 1965 in the North Fork of the Alsea River on the Oregon coast to determine the importance of release time, within the spring migratory period, on adult returns. Fish stocked in April survived better than fish stocked in February and March. The migration pattern for fish leaving a raceway voluntarily was similar to that of wild smolts in the stream. Similar numbers of fish returned from both the voluntary and mid-April liberation groups. Mid-April appeared to be the most favorable time for stocking hatchery-reared steelhead on the Alsea River. A voluntary release method did not significantly increase survival. (Auth.)

10454. Morris, Larry A., Ralph N. Langemeier, Thomas R. Russell, and Arthur Witt, Jr. (Nebraska Game and Parks Comm., Lincoln, Nebr.). 1968. EFFECTS OF MAIN STEM IMPOUNDMENTS AND CHANNELIZATION UPON THE LIMNOLOGY OF THE MISSOURI RIVER, NEBRASKA. Trans. Amer. Fish. Soc., 97(4): 380-388.

Rigid control has been imposed upon the Missouri River by impounding over one-half of the upper 1,500 miles and by channeling most of the remaining river within permanent, narrow banks. These controls have caused environmental changes in the lower Missouri River, as shown by this study, of adjacent unchanneled and channelized sections of river below the main stem impoundments. Impoundments have regulated flow by evening maximum and minimum discharges and improved downstream water quality by decreasing turbidity and indirectly raising the dissolved oxygen. In addition the impoundments have contributed a limnetic cladoceran, Leptodora kindti, to the drift and have affected the distribution of benthos through the modification of turbidity. Channelization of the river has reduced both the size and variety of aquatic habitat by destroying key productive areas. Average standing crops of benthos were similar in unchanneled and channelized river (0.63 and 0.67 pounds per acre, respectively) but the benthic area had been reduced 67% by channelization. In the channelized river the average

standing crop of drift was 8 g per acre-foot while in the unaltered river the average standing crop was 68 g per acre-foot. There was little similarity between the organisms of the drift and benthos; however there was similarity between the organisms in the drift and the aufwuchs. (Authors)

10455. Elser, Allen A. (Montana Fish and Game Dept., Bozeman, Mont.). 1968. FISH POPULATIONS OF A TROUT STREAM IN RELATION TO MAJOR HABITAT ZONES AND CHANNEL ALTERATIONS. Trans. Amer. Fish. Soc., 97(4): 389-397.

The relationship of fish populations to major habitat zones and channel alterations was studied in Little Prickly Pear Creek, Montana, during the summers of 1965 and 1966. Five major zones were defined as follows: headwater, meadow, mountain, lower meadow, and Wolf Creek Canyon, with at least one representative study section in each. Approximately 23% (6 of 30 miles) of the stream has been altered. Field measurements showed no pool-riffle periodicity in the altered mountain sections, while successive riffles were spaced at intervals of 5.7 widths, in the unaltered areas. Altered sections of the mountain zone consisted, by area, of 87% shallow-fast with no deep-slow water, compared to 49 and 14%, respectively, for the unaltered sections. Amount of cover per acre of stream was about 80% greater in the unaltered mountain section than in the altered. Rock deflectors in the altered section of Wolf Creek Canyon rendered the physical characters of the stream nearly comparable to the unaltered sections. Fish populations were estimated by means of a simple mark-and-recapture census. Non-trout species were absent from the altered sections, but made up 30 and 58% of the total number and weight, respectively, in the unaltered mountain sections. Trout were 78% more abundant in the unaltered mountain sections than in the altered, and a statistical test indicated a significant difference between the two trout populations. Standing crops of trout ranged from 40 to 226 pounds per acre, and the total stream supported an estimated 20,400 trout greater than 4.0 inches long weighing 9,500 pounds. Channel alterations resulted in a total loss of 4,700 trout with a total weight of 2,200 pounds. (Auth.)

10456. Johnson, Donald W. (Dept. of Zoology, Arizona State Univ., Tempe, Ariz.). 1968. PESTICIDES AND FISHES—A REVIEW OF SELECTED LITERATURE. Trans. Amer. Fish. Soc., 97(4): 398-424.

This paper reviews selected literature on pesticide interactions in aquatic habitats, with special reference to their effects on fishes, and is hopefully an objective critique of research to date, and a projection of future needs in this field. The questions that have been asked are compared to the answers that must be provided. Factors (physical and biological) that affect toxicity are presented to define the data required for the judgment of a "safe" environmental concentration as related to LC₅₀ (mean lethal concentration). Residue analyses give some indications of the action and effects of pesticides on fishes and their ecosystems. Analytical techniques are briefly reviewed. Research programs necessary for the detection of any sublethal damage to a population are suggested in the hope that in the near future direct mortality may not be the chief criteria of danger from pesticides. (Auth.)

10457. Kemmerer, Andrew J. (Arizona Game and Fish Dept., Phoenix, Ariz.). 1968. A METHOD TO DETERMINE FERTILIZATION REQUIREMENTS OF A SMALL SPORT FISHING LAKE. Trans. Amer. Fish. Soc., 97(4): 425-428.

Translucent polyethylene film tubes isolated columns of lake water in which to study fertilization requirements in situ. Production estimates based on gross photosynthesis, chlorophyll-a, and zooplankton measurements indicated that the tubes performed well. Other measurements including temperature and oxygen stratification and photic depth determinations showed that the tubes did not measurably alter the physical characteristics of the columns of water. Gross photosynthesis and chlorophyll based production estimates reflected similar responses of productivity to treatment. The response of zooplankton to treatment was not as clear. (Auth.)

10458. Krumholz, Louis A., and Harold S. Cavanah (Dept. of Biology, Univ. of Louisville, Louisville, Ky.). 1968. COMPARATIVE MORPHOMETRY OF FRESH-WATER DRUM FROM TWO MIDWESTERN LOCALITIES. Trans. Amer. Fish. Soc., 97(4): 429-441.

A comparison of meristic and morphological characteristics in series of freshwater drum from the lower Ohio River, Kentucky, and Lake Winnebago, Wisconsin, indicates that there are statistically significant differences in some measurements along the long axis of the body. However, there is a remarkable stability among meristic characteristics within the species that has persisted essentially in its present form since early postglacial times. (Authors)

10459. Swedberg, Donald V. (North Central Reservoir Investigations, Bureau of Sport Fisheries and Wildlife, Yankton, S.D.). 1968. FOOD AND GROWTH OF THE FRESHWATER DRUM IN LEWIS AND CLARK LAKE, SOUTH DAKOTA. Trans. Amer. Fish. Soc., 97(4): 442-447.

Age 0 freshwater drum in Lewis and Clark Lake, a main stem Missouri River reservoir, consumed mostly zooplankton and chironomids, and age I and older fish consumed mostly Hexagenia. Zooplankton were important during the entire summer for age 0 fish, but were important only during the spring and fall for older fish. Bottom organisms were important food for age 0 fish longer than 40 mm and for age I and adults. A study of diurnal food habits revealed most zooplankton were consumed during daylight and most Hexagenia during darkness. Freshwater drum growth was poor during the first 6 years after impoundment (1956-61), then improved between 1962 and 1966. Improved growth was related to an increase in Hexagenia abundance and was accompanied by an increase in freshwater drum density. (Auth.)

10460. Hill, Loren G. (Dept. of Zoology, Univ. of Oklahoma, Norman, Okla.). 1968. OXYGEN PREFERENCE IN THE SPRING CAVEFISH, Chologaster agassizi. Trans. Amer. Fish. Soc., 97(4): 448-454.

Chologaster agassizi exhibits a preference for high over low oxygenated water; however, the cavefish does not discriminate between oxygen concentrations of 2 mg/l or less, whether the two concentrations are relatively high or low. The tolerance point for oxygen preference appears to be near 6 mg/l with higher concentrations giving no observable preference. The stimulus to avoid light is more pronounced than the stimulus to select against low oxygen conditions. The reactions of the cavefish to oxygen conditions appear to be attributed to the fish sensing the unfavorable nature of the water and searching for a more desirable area. Included among the intrinsic factors involved in the migration of Chologaster from the cave to the epigeal environment may be the preference for dark and high oxygen conditions. (Auth.)

10461. Rolan, Robert G. (Dept. of Zoology and Physiology, Univ. of Nebraska, Lincoln, Nebr.). 1968. ELECTROPHORETIC COMPARISON OF HUMAN AND CATFISH PLASMA PROTEINS. Trans. Amer. Fish. Soc., 97(4): 455-459.

Polyacrylamide gel electropherograms of the sera of 13 ictalurids and one ariid were compared with that of human serum. Electrophoresis was combined with precipitation to identify albumins and globulins, and with differential staining to identify lipoproteins, glycoproteins, cytochrome oxidase, and haptoglobins. Parallel electrophoresis of serum and plasma from the same individual fishes was used to locate fibrinogen. Albumins and globulins were present in all catfish sera. The electrophoretic patterns of the ictalurids were quite similar to one another and to the serum pattern of the ariid although the latter was still distinctive. Catfish serum patterns are unlike that of human serum. Human albumin migrates more rapidly, but it is chemically similar to one of the albumins of catfish in being composed of both lipoprotein, glycoprotein, and having cytochrome oxidase activity. Human and catfish albumin evidently differ in their nonspecific binding abilities. Human and catfish sera differ in their relative amounts of glycoproteins, carbohydrate moieties being present in all human serum fractions but only in two fractions of catfish sera. Human and ictalurid fibrinogen have similar electrophoretic mobilities. There are lipoprotein fractions, which may be beta-lipoprotein of very low mobility in both human and catfish sera. Haptoglobins do not occur in catfish sera. (Auth.)

10462. Coke, Michael (Natal Parks, Game and Fish Preservation Board, Pietermaritzburg, Natal, S. Africa). 1968. DEPTH DISTRIBUTION OF FISH ON A BUSH-CLEARED AREA OF LAKE KARIBA, CENTRAL AFRICA. Trans. Amer. Fish. Soc., 97(4): 460-465.

Distributions of fish of commercial importance on a bush-cleared area in Lake Kariba was studied using six-inch stretch mesh gillnets. Yields of fish per hundred yards of net set were found to be greater in benthic waters than at the surface, and to decrease markedly with increasing depth of water. Yields from nets set perpendicular to the shore in five feet of water were significantly greater than yields from any other depth, irrespective of direction of set. (Auth.)

10463. Etnier, David A. (Dept. of Zoology, Univ. of Tennessee, Knoxville, Tenn.). 1968. REPRODUCTIVE SUCCESS OF NATURAL POPULATIONS OF HYBRID SUNFISH IN THREE MINNESOTA LAKES. Trans. Amer. Fish. Soc., 97(4): 466-471.

Several investigators have demonstrated the ability of certain hybrid sunfish to reproduce in controlled situations. Three lakes in northern Minnesota that contained large numbers of natural sunfish hybrids were investigated to determine the extent of reproduction of these fish in natural environments. Presence of living embryos in nests guarded by male hybrids indicated a potentially significant amount of reproduction by the hybrids. A comparison of the distribution of the ratio of pectoral fin length to jaw length for the populations involved suggested that few, if any, second generation hybrids were present in the adult population. It is suggested that reduced vigor or the inability to compete with other sunfishes prevented these fish from becoming an integral part of the total sunfish population. (Auth.)

10464. Shetter, David S. (Michigan Dept. of Conservation, Lewiston, Mich.). 1968. OBSERVATIONS ON MOVEMENTS OF WILD TROUT IN TWO MICHIGAN STREAM DRAINAGES. Trans. Amer. Fish. Soc., 97(4): 472-480.

This report deals with the migration of wild brook trout and brown trout, over 7 inches long, in Hunt Creek and the upper Au Sable River system. Between 1934 and 1967 we jaw-tagged 3,320 brook trout and 5,615 brown trout; anglers recaptured and reported 346 of the brook trout and 480 brown trout. Brook trout were recaptured close to where they had been tagged and released—88% within 1 mile, the remainder within 11 miles. Migration of brown trout (in the Au Sable system) was more variable. Seven- to 13-inch brown trout remained (56-85%) within 1 mile of tagging sites. Many browns over 13 inches in the North and South Branches Au Sable migrated several miles (some up to 10 to 40 miles), but in the Main Au Sable 90% of the big browns were less than 1 mile from tagging site. Spring-tagged trout produced twice as many returns as did fall-tagged fish. Brook trout recoveries were 97% within the first year after tagging; 67% of the browns came within the first year; the other 33%, in 2 to 5 years. (Auth.)

10465. Rahrer, Jerold F. (Bur. of Commercial Fisheries Biological Station, Ashland, Wisc.). 1968. MOVEMENTS OF ADULT LAKE TROUT IN LAKE SUPERIOR. Trans. Amer. Fish. Soc., 97(4): 481-484.

10466. Manion, Patrick J. (Bur. of Commercial Fisheries Biological Station, Marquette, Mich.). 1968. PRODUCTION OF SEA LAMPREY LARVAE FROM NESTS IN TWO LAKE SUPERIOR STREAMS. Trans. Amer. Fish. Soc., 97(4): 484-486.

10467. Radulescu, I., D.G. Vasiliu, E. Ilie, and S.F. Snieszko. 1968. THYROID HYPERPLASIA OF THE EASTERN BROOK TROUT, Salvelinus fontinalis, IN ROMANIA. Trans. Amer. Fish. Soc., 97(4): 486-488.

10468. Kitchell, J.F., and J.T. Windell (Fish Physiology Lab., Univ. of Colorado, Boulder, Colo.). 1968. RATE OF GASTRIC DIGESTION IN PUMP-KINSEED SUNFISH, Lepomis gibbosus. Trans. Amer. Fish. Soc., 97(4): 489-492.

10469. Lewis, William M., Roy Heidinger, and Mark Konikoff (Fishery Research Lab., Southern Illinois Univ., Carbondale, Ill.). 1968. LOSS OF FISHES OVER THE DROP BOX SPILLWAY OF A LAKE. Trans. Amer. Fish. Soc., 97(4): 492-494.
10470. Sheldon, Andrew L. (Univ. of California, Sagehen Creek Field Station, Truckee, Calif.). 1968. DRIFT, GROWTH, AND MORTALITY OF JUVENILE SCULPINS IN SAGEHEN CREEK, CALIFORNIA. Trans. Amer. Fish. Soc., 97(4): 495-496.
10471. McErlean, Andrew J., and Victor S. Kennedy (Univ. of Maryland, Natural Resources Inst., Hallowing Point Station, Prince Frederick, Md.). 1968. COMPARISON OF SOME ANESTHETIC PROPERTIES OF BENZOCAINE AND MS-222. Trans. Amer. Fish. Soc., 97(4): 496-498.
10472. Burke, W. David, and Denzel E. Ferguson (Dept. of Zoology, Mississippi State Univ., State College, Miss.). 1968. A SIMPLIFIED FLOW-THROUGH APPARATUS FOR MAINTAINING FIXED CONCENTRATIONS OF TOXICANTS IN WATER. Trans. Amer. Fish. Soc., 97(4): 498-501.
10473. Solon, Joseph M., Jeffrey L. Lincer, and John H. Nair, III (Life Sciences Div., Syracuse Univ. Res. Corp., Merrill Lane—Univ. Heights, Syracuse, N. Y.). 1968. A CONTINUOUS FLOW, AUTOMATIC DEVICE FOR SHORT-TERM TOXICITY EXPERIMENTS. Trans. Amer. Fish. Soc., 97(4): 501-502.
10474. Coler, Robert A., Haim B. Gunner, and Bert M. Zuckerman (Inst. of Agricultural and Industrial Microbiology, Univ. of Massachusetts, Amherst, Mass.). 1968. TUBIFICID SENSITIVITY TO STREPTOMYCIN. Trans. Amer. Fish. Soc., 97(4): 502-503.
10475. Harris, Alva H., and Curt D. Rose (Div. of Marine Science, Nicholls State College, Thibodaux, La.). 1968. SHRIMP PREDATION BY THE SEA CATFISH, Galeichthys felis. Trans. Amer. Fish. Soc., 97(4): 503-504.
10476. Dawson, C. E. (Gulf Coast Research Lab., Ocean Springs, Miss.). 1968. CONTRIBUTIONS TO THE BIOLOGY OF THE MEXICAN FLOUNDER, Cyclopsetta chittendeni, IN THE NORTHERN GULF OF MEXICO. Trans. Amer. Fish. Soc., 97(4): 504-507.
10477. Brinser, Ayers, Lloyd L. Smith, Jr., H. C. Frick, and F. E. J. Fry (Dept. of Conservation, Univ. of Michigan, Ann Arbor, Mich.). 1968. AN ECONOMIC EVALUATION OF SEA LAMPREY CONTROL AND LAKE TROUT RESTORATION IN LAKE SUPERIOR. Great Lakes Fishery Commission, 1451 Green Road, Ann Arbor, Mich. 49 p. Appendices.
10478. Locke, David O., and Stanley P. Linscott (Maine Dept. of Inland Fisheries and Game, Augusta, Me.). 1969. A NEW DRY DIET FOR LANDLOCKED SALMON AND LAKE TROUT. Progr. Fish Cult., 31(1): 3-10.
- Feeding tests to compare the dry Ewos salmon diet and 100% beef liver were made in three Maine hatcheries for 2 years, using landlocked Atlantic salmon (Salmo salar) and lake trout (Salvelinus namaycush). Fish protein concentrate (FPC) is one of the primary components of this high-protein diet, and the pellets also contain poikilothermic animal fat. Ewos-fed fish ranged in size from only slightly larger to 2.7 times larger than their meat-fed controls. The cost of Ewos per pound of fish produced was less than half the cost for meat-fed fish, although the dry diet was more expensive than beef liver; this indicates much better conversion of pellets than of a meat diet. Mortalities were only slightly higher in Ewos-fed groups than in control groups. The numbers of calories and grams of protein necessary in the Ewos diet to produce a pound of fish were less for lake trout, and the same for salmon as previous workers have reported for brown trout on high-calorie diets. Ewos feeding tables for both species are included. (Authors)

10479. Leach, J.H. (Dept. of Zoology, Univ. of Guelph, Guelph, Ont., Canada). 1969. SEASONAL LIMNOLOGY OF AN EXCAVATED POND IN SOUTHERN ONTARIO. Progr. Fish Cult., 31(1): 11-19.

Environmental characteristics of a 1-acre (0.4-ha) mature, excavated pond were followed intensively for 12 months. By ground seepage and extensive submerged plant growth, deep-water summer temperatures were maintained within satisfactory limits for rainbow trout (Salmo gairdneri) production. Highest phytoplankton numbers occurred under the ice and contributed to safe dissolved oxygen levels during severe winter conditions. Agricultural practices in the drainage area increased nutrient levels and eutrophication of the pond. (Auth.)

10480. Windell, J.T., and D.O. Norris (Biology Dept., Univ. of Colorado, Boulder, Colo.). 1969. GASTRIC DIGESTION AND EVACUATION IN RAINBOW TROUT. Progr. Fish Cult., 31(1): 20-26.

The rate of gastric digestion and evacuation was determined for Salmo gairdneri acclimated to 15° C. Data, expressed as percentage of decrease of digestible organic matter from the stomach, represent the difference between weight of food intake and food remains at several time intervals. Digestible organic matter is defined as dry weight minus ash weight and chitin weight. Natural food organisms (oligochaetes) were processed initially at a faster rate than chitinized unnatural food organisms (mealworm larvae) or commercial trout pellets. Complete gastric evacuation after an initial experimental meal required about 36 hours for each food item. No gastric evacuation of oligochaetes was measurable or observable after 4 hours, but 25% of the original meal (3.2 g) had disappeared at the 8-hour interval. Approximately 45% of the meal was digested, evacuated, and/or absorbed during the next 4 hours, reaching 69.1% decrease at the 12-hour analysis. An additional 24-hour period was required to remove the remaining 30% of the original meal. Trout acclimated during winter to short photoperiod at 15° C digested an average meal of oligochaetes at the same rate as trout in the summer experiments maintained at 15° C on long photoperiod. Seasonal rhythm in the digestive physiology may not exist in this species, and differences in rates of gastric digestion and evacuation are likely a function of temperature. (Authors)

10481. Wellborn, Thomas L., Jr. (Bur. of Sport Fisheries and Wildlife, Fisheries Center, Auburn Univ., Auburn, Ala.). 1969. THE TOXICITY OF NINE THERAPEUTIC AND HERBICIDAL COMPOUNDS TO STRIPED BASS. Progr. Fish Cult., 31(1): 27-32.

The toxicity of 9 therapeutic and herbicidal compounds to striped bass (Roccus saxatilis) was determined by means of standard bioassay procedures. Of the compounds tested--copper sulfate, Diquat, Dylox, formalin, Globe Terramycin Pet Tabs, Karmex, potassium permanganate, Polyotic, and simazine--simazine and copper sulfate were the most toxic (LC₅₀ of 0.25 and 0.62 ppm, respectively, at 96-hour exposure), and Polyotic was the least toxic (LC₅₀ of >1,818 ppm for 96-hour exposure). (Auth.)

10482. Kennedy, Harry D., and David Walsh (Bur. of Sport Fisheries and Wildlife, Fish-Pesticide Research Lab., Columbia, Mo.). 1969. AN AID FOR SORTING MACROINVERTEBRATES OR MICROINVERTEBRATES. Progr. Fish Cult., 31(1): 32.

A device for use with a dissecting microscope to sort bottom fauna samples can be made from glass plate, glass rod, and plastic tubing.

10483. Howland, Robert M. (Bur. of Sport Fisheries and Wildlife, Fish Control Lab., La Crosse, Wisc.). 1969. INTERACTION OF ANTIMYCIN A AND ROTENONE IN FISH BIOASSAYS. Progr. Fish Cult., 31(1): 33-34.

Antimycin A and rotenone were bioassayed separately and in combination against rainbow trout (Salmo gairdneri) and bluegills (Lepomis macrochirus) to determine whether interaction occurs upon admixture of the two piscicides. The combination of antimycin A and rotenone was more toxic than either of the toxicants alone; however, the degree of potentiation was slight. (Auth.)

10484. Hoffman, Glenn L., and Robert E. Putz (Bur. of Sport Fisheries and Wildlife, Eastern Fish Disease Lab., Kearneysville, W. Va.). 1969. HOST SUSCEPTIBILITY AND THE EFFECT OF AGING, FREEZING, HEAT, AND CHEMICALS ON SPORES OF Myxosoma cerebralis. Progr. Fish Cult., 31(1): 35-37.

The spores of Myxosoma cerebralis were not infective shortly after removal from the fish, but were so after 4 months of "aging" in spring water. Spores frozen 18 days at -20° C and "aged" 4 months in spring water were infective for trout. Spores were distorted and probably were killed at 60° to 100° C, but not at 40° C. Spores were probably killed after 24-hour exposure to calcium hydroxide (0.5 and 2%), available chlorine (as sodium hypochlorite) at 1,600 ppm, and Roccal at 200 and 800 ppm. The host range of whirling disease was extended to include coho salmon (Oncorhynchus kisutch), chinook salmon (O. tshawytscha) and lake trout (Salvelinus namaycush). (Authors)

10485. Bryan, Robert D., and Kenneth O. Allen (Bur. of Sport Fisheries and Wildlife, Tupelo National Fish Hatchery, Tupelo, Miss.). 1969. POND CULTURE OF CHANNEL CATFISH FINGERLINGS. Progr. Fish Cult., 31(1): 38-43.

Methods of producing channel catfish (Ictalurus punctatus) fingerlings at the Tupelo National Fish Hatchery from 1959 to 1966 are described. Brood fish were spawned in pens, the eggs were allowed to hatch naturally, and fry were transferred directly to rearing ponds. In 1964, the number of fingerlings harvested from each spawn averaged 21,400. Predaceous aquatic insects were controlled by delayed filling of the rearing ponds, and by a 1:4 solution of cottonseed oil and diesel oil applied to the water surface at a rate of 3 to 4 gallon per acre. Scyphidia sp., Ichthyophthirius multifiliis, and monogenetic trematodes were controlled in ponds with formalin and copper sulfate. Suitable levels of dissolved oxygen were maintained and excessive phytoplankton blooms were controlled by pumping well water into the ponds. Rooted vegetation and algae were controlled with simazine and diuron. The fish were fed a floating trout food. Conversion (S value) averaged 0.9. Approximately 75% of the fingerlings were harvested with a seine while feeding. In 1964, 1,411,500 channel catfish fingerlings weighing 12,546 pounds were produced in 5.9 acres of water. This was an average of 239,000 fingerlings (2,126 lb) per acre. (Authors)

10486. Lewis, William M., Roy Heidinger, and Mark Konikoff (Fisheries Research Lab., and Dept. of Zoology, Southern Illinois Univ., Carbondale, Ill.). 1969. ARTIFICIAL FEEDING OF YEARLING AND ADULT LARGEMOUTH BASS. Progr. Fish Cult., 31(1): 44-46.

Largemouth bass (Micropterus salmoides), 6 to 18.5 inches long, were stocked in 4 ponds (approximately 0.1 acre each). The rates of stocking ranged from 311 to 794 pounds per acre. In one experiment the fish in 2 ponds were fed frozen tadpoles for 47 days; 2 ponds were maintained as controls. In a second experiment the fish in 3 ponds were fed trout chow (in moist balls 0.75 inch in diameter) for 68 days. In the first experiment, in the experimental ponds, 46% and 74% of the bass fed on tadpoles. Survival in all ponds was above 90%. The fish that fed had 42% and 51% gains in body weight, while the controls and non-feeders had a weight loss of 0% to 34%. In the second experiment 38% to 70% of the fish fed. The survival in all ponds was above 80%. The fish that fed had a gain in weight of 22% to 45%; the fish in the control ponds had a weight loss of 21%. (Authors)

10487. Perry, W. Guthrie, Jr. (Louisiana Wild Life and Fisheries Comm., Grand Chenier, La.). 1969. FOOD HABITS OF BLUE AND CHANNEL CATFISH COLLECTED FROM A BRACKISH-WATER HABITAT. Progr. Fish Cult., 31(1): 47-50.

Food habits of blue catfish (Ictalurus furcatus) and channel catfish (I. punctatus) taken from brackish waters are described. Stomachs of 59 blue catfish and 40 channel catfish were examined. The diet of blue catfish of the smallest size group (95-187 mm) included small invertebrates such as amphipods, shrimp, and insects. The transition from small invertebrates to fish and macroinvertebrates seemed to

occur when the catfish were 293 mm in total length. Young channel catfish, like blue catfish, fed primarily on small bottom-living animals. A change from invertebrates to fish and larger animals appeared to take place when the channel catfish were about 376 mm long. Both species were predatory long before they reached the 16-inch group. (Auth.)

10488. Moyle, Peter B. (Dept. of Zoology, Univ. of Minnesota, Minneapolis, Minn.). 1969. COMPARATIVE BEHAVIOR OF YOUNG BROOK TROUT OF DOMESTIC AND WILD ORIGIN. *Progr. Fish Cult.*, 31(1): 51-56.

Behavior of brook trout (*Salvelinus fontinalis*) fry of a domestic strain is compared with the behavior of fry reared from the eggs of 2 strains of wild brook trout (F₁-wild trout). Behavior patterns of the 2 strains of F₁-wild trout were essentially identical. The vertical distribution pattern of fry in experimental aquaria largely supported the findings of R. E. Vincent that F₁-wild fry tend to orient themselves strongly to the bottom while domestic fry tend to distribute themselves evenly throughout a water column. There was considerable variation in this behavior, particularly among the domestic fry. In large aquaria, in which fry were raised from the alevin stage, domestic fry showed a much greater tendency to swim about at all levels, while the F₁-wild fry tended to remain close to the bottom. Orientation to the bottom became less marked as fry of both types grew older. Fry of both types occasionally defended territories, but the domestic fry were more aggressive than the F₁-wild fry. (Auth.)

10489. Regier, Henry A. (Univ. of Toronto, Toronto, Canada). 1969. FISH SIZE PARAMETERS USEFUL IN ESTIMATING GILL-NET SELECTIVITY. *Progr. Fish Cult.*, 31(1): 57-59.

The need is for more research on problems related to sampling. Measurements of girth and total length have been used as parameters in gill-net selectivity, but for better selectivity estimates fishery biologists should devise a number of standard gears and standard methods of using them.

10490. Cisar, Clayton F. (Harborton Marine Lab., Harborton, Va.). 1969. AN AERATION DEVICE FOR TRANSPORTING LIVE MARINE SPECIMENS. *Progr. Fish Cult.*, 31(1): 60-61.

A compact aeration device has been developed for use in transporting live marine and aquatic specimens from the point of capture to the laboratory. This device operates on either 6- or 12-volt d. c. batteries or 115-volt a. c. household current. (Auth.)

10491. Konar, S. K. (Dept. of Zoology, Univ. of Bihar, Muzaffarpur, Bihar, India). 1969. EFFECTS OF HEPTACHLOR AND NICOTINE ON THE BARBELS OF A CATFISH (*Heteropneustes fossilis*). *Progr. Fish Cult.*, 31(1): 62-63.

The barbels of the exposed catfish curled within 2 hours in heptachlor and within 5 hours in nicotine. All exposed fish died within 44 and 18 hours, respectively, in heptachlor and nicotine dilutions. Major pathological changes induced in barbels included rupture of epidermal cells, deformation and sinking of taste buds, and swelling and increment in many mucous cells. Changes induced by nicotine consisted of degeneration of some epidermal cells, and swelling and bulging of taste buds.

10492. Ellis, James N. (Oceanic Inst., Makapuu Oceanic Center, Waimanalo, Hawaii). 1969. DEVICE FOR HOLDING JUVENILE FISH. *Progr. Fish Cult.*, 31(1): 63-64.

A device which will immobilize small fish is described. Permitting examination or measurements without injury to the fish, this is a simple and useful tool for both field and laboratory. (Auth.)

10493. Bohlke, James E., and Charles C. G. Chaplin. 1968. FISHES OF THE BAHAMAS AND ADJACENT TROPICAL WATERS. Livingston Publishing Co., Wynnewood, Pa. 771 p. Illus.

10494. Brown, V.M. 1968. THE CALCULATION OF THE ACUTE TOXICITY OF MIXTURES OF POISONS TO RAINBOW TROUT. *Water Research*, 2(10): 723-733.

The estimation of the acute toxicity to trout of mixtures of the common industrial pollutants ammonia, phenol, zinc, copper, cadmium, lead, nickel, and hydrogen cyanide is described. This is done from a knowledge of the concentrations of these poisons and of the temperature, pH value, total hardness, bicarbonate alkalinity, total dissolved solids concentration, and dissolved-oxygen concentration of the dilution water. The toxicity of the mixture is taken to be the sum of the proportions of the acutely toxic concentration of each poison. The assumptions made in the use of this method are discussed along with its limitations, and the fact that in critical areas of study, such estimates can never be substitutes for the actual determination of the toxicity of a water by the use of fish is stressed. (Auth.)

10495. Bashline, L. James. 1969. KEYSTONE COHO. *Field and Stream*, 83(12): 54-55, 172-173.

About two years ago coho salmon were planted in Lake Erie by the Pennsylvania Fish Commission. Although many thought the lake too polluted, there was a run of several thousand precocious jack salmon last fall and it appears that the fish are doing better than expected.

10496. Dean, Jim. 1969. CAROLINA SHAD COMEBACK. *Field and Stream*, 83(12): 58-59, 126, 128, 130, 132.

In 1915 the Corps of Engineers built a dam in the Cape Fear River near Wilmington to aid navigation. It cut off the spawning run of American shad. In 1962 some releases through the lower of a series of three locks permitted about 1,000 shad to continue their spawning run upriver. In 1966 the second lock upstream near Elizabethtown, and in 1967 the upper lock, was opened to permit some passage of spawning shad. In 1968 more than 20,000 shad were passed through the locks and the sport catch increased enough to attract widespread angler interest.

10497. Roser, Louis A. 1969. WHERE THE SALMON GO. *Field and Stream*, 83(12): 62-63, 205, 207, 209, 211.

Three University of Washington scientists have, since 1955, collected data concerning migration patterns of Pacific salmon. It was found that all five species follow common paths in the open sea, and huge numbers of salmon are sometimes concentrated together. It is important that we use such newly acquired information to protect and manage the salmon rather than to facilitate the harvest of too many.

10498. Niehuis, Charles C. 1969. STRIPERS IN THE BIG RED. *Field and Stream*, 83(12): 68-69, 220-224.

The first striped bass stocked in the Colorado River at Blythe, California, in April 1959 were 996 fingerlings trapped in the San Joaquin River. More fingerlings and some yearlings were released near Blythe. Between 1962 and 1964 some 83,000 fingerlings and 335 yearlings were planted in Lake Havasu above Parker Dam. There is evidence that these fish are now reproducing successfully in the river.

10499. Warner, K., R.P. Auclair, S.E. DeRoche, K.A. Havey, and C.F. Ritzi (Maine Dept. of Inland Fisheries and Game, Augusta, Me.). 1968. FISH PREDATION ON NEWLY STOCKED LANDLOCKED SALMON. *J. Wildlife Mgmt.*, 32(4): 712-717.

To evaluate the extent of predation by various fishes on newly stocked landlocked salmon (*Salmo salar*), 21 Maine lakes were gillnetted or trapnetted following stocking in 1965-67. Chain pickerel were found to be the most common predator. Evidence of pickerel predation on stocked salmon was found in 11 (69%) of 16 study waters. Of 173 pickerel examined, 53 (31%) contained 1 or more newly stocked salmon. For those pickerel stomachs containing salmon, there was an average of 1.6 salmon per pickerel. There appeared to be little selection for size of salmon

prey by pickerel. Of 48 lake trout examined from six lakes, only 2 fish (4%) contained salmon stocked as spring yearlings. Only one occurrence of cannibalism was found in 53 salmon examined from 8 lakes. Stocked salmon were found in 1 (3%) of the 32 burbot stomachs examined. Of 203 yellow perch examined from 11 lakes, 7 fish (4%) contained stocked salmon. No evidence was found of salmon predation by brook trout, white perch, smallmouth bass, or fallfish. The possible effects of predation by the various fishes on overall salmon survival are discussed. Possible methods for reducing predation by pickerel are suggested. (Authors)

10500. Dando, P.R. 1969. LACTATE METABOLISM IN FISH. *J. mar. biol. Ass. U.K.*, 49(1): 209-223.

The activity of lactate dehydrogenase was measured in the livers of 36 species of fish. These species could be divided into two groups, those with liver activities of more than 1,000 mU/mg protein and those with activities of less than 100 mU/mg protein. The lactate and pyruvate of samples of blood, muscle and liver from cod, plaice, bass and mackerel were determined. Samples were taken from "rested" and trawled fish and from fish allowed to recover for 3 hours after trawling. The rate of removal of lactate from the white muscle after capture in the trawl was not related to high blood and liver activities of lactate dehydrogenase. There was no relationship between the activities of nine of the glycolytic enzymes in the white muscle of cod and plaice and the liver lactate dehydrogenase activity. Little blood lactate appears to be taken up by the liver. It is concluded that the liver of cod, plaice and bass has a negligible role in metabolizing blood lactate. (Auth.)

10501. Goldman, Charles R. (Dept. of Zoology and Institute of Ecology, Univ. of California, Davis, Calif.). 1968. AQUATIC PRIMARY PRODUCTION. *Am. Zoologist*, 8(1): 31-42.

The ecosystem concept has been particularly useful and extensively employed in the study of aquatic primary productivity. The flow of energy through the system is an attractive area of investigation when it involves some process, but has a more restricted value when units of biomass are simply converted to calories. Although we are able to measure primary productivity in terms of the carbon fixed, we are not yet able to measure the actual change in the oxidative state of the newly fixed carbon. The fate of photosynthate as food for higher trophic levels is therefore dependent upon a considerable array of biological and environmental variables. Primary productivity is considered in terms of its evolution from measures of standing crop and yield, which have been gradually replaced by measures of rate of carbon uptake or oxygen production, or by measure of nutrient loss, or by change of CO₂ in the environment. Data from five lakes are used to illustrate the evolutionary thread of eutrophication and the great range in primary productivity to be expected on the basis of either unit volume or unit surface area at different trophic states. Light and nutrients are important in limiting primary productivity, and are contributing factors to the great variability which one may encounter within a given lake. Only with a sounder understanding of productivity at the base of the food-chain can we have any real hope of controlling the productivity of aquatic environments for the benefit of man. (Auth.)

10502. Slobodkin, Lawrence B. (Dept. of Zoology, Univ. of Michigan, Ann Arbor, Mich.). 1968. HOW TO BE A PREDATOR. *Am. Zoologist*, 8(1): 43-51.

This paper discusses what would appear to be the optimal strategy of a predator given two alternative objectives: (1) maximum yield commensurate with the long-term maintenance of the prey species, and (2) extinction of the prey species. The problem is examined in terms of past research on *Daphnia* and *Hydra*, and takes into account estimates of ecological efficiency, population efficiency, and growth efficiency based on many laboratory experiments. It is shown that there may be distinct differences in the effects of removing different kinds of individuals from a prey population. The optimal system for a predator wishing to insure the continued availability of its prey is to take animals which are about to die anyway, i.e., to alter the natural pattern of mortality as little as possible. It is concluded, with some reservations, that predators in nature generally act in this manner. Conversely, if one's intent is to exterminate a prey species (e.g., an objectionable pest), the animals removed should be those which natural predators do not select. (Auth.)

10503. Krueger, Hugo M., James B. Saddler, Gary A. Chapman, Ian J. Tinsley, and Robert R. Lowry (Depts. of Fisheries and Wildlife and of Agricultural Chemistry, Oregon State Univ., Corvallis, Oreg.). 1968. BIOENERGETICS, EXERCISE, AND FATTY ACIDS OF FISH. *Am. Zoologist*, 8(1): 119-129.

The bioenergetic aspects of pentachlorophenol poisoning and exercise in fish are discussed. When cichlids were exposed to 0.2 ppm of pentachlorophenol, the intake of food was increased and energy losses were also increased. Growth was decreased. The cost of specific dynamic action was higher and the cost of exercise was increased above the cost of similar exercise in nonpoisoned controls. In salmon swimming to exhaustion at 52 cm/sec fatty acids 18:1, 16:0, and 16:1, and at 59 cm/sec fatty acids 22:6, 18:2, and 20:4 suffered the greatest depletion. At 52 and 59 cm/sec, respectively, average exhaustion times were 1,141 and 398 minutes; the equivalents of distance traveled were 26.0 and 12.7 miles; the loss in lipids, 54 and 10 mg; and the average weight losses, 830 and 480 mg per salmon. Total caloric losses calculated from the data on lipid and weight losses were approximately 1,118 and 566 calories. Calculated from the data of Brett (1964) on O_2 -consumption, caloric losses were estimated at only 344 and 188 calories. The difference between observed values and values calculated from the data of Brett may lie in the duration and severity of the exercise. Brett collected his data on O_2 -consumption on the basis of at most two hours at high velocity. Possibly when maximum effort is involved each succeeding mile and each succeeding hour is more difficult and more costly to the salmon. (Authors)

10504. Randall, D. J. (Dept. of Zoology, Univ. of British Columbia, Vancouver 8, B. C., Canada). 1968. FUNCTIONAL MORPHOLOGY OF THE HEART IN FISHES. *Am. Zoologist*, 8(2): 179-189.

The systemic heart of fishes consists of four chambers in series, the sinus venosus, atrium, ventricle, and conus or bulbus. Valves between the chambers and contraction of all chambers except the bulbus maintain a unidirectional blood flow through the heart. The heart is composed of typical vertebrate cardiac muscle, although there may be minor differences in the distribution of spontaneously active cells, the rate and nature of spread of excitatory waves, and the characteristics of resting and action potentials between different fish and other vertebrates. Cholinergic fibers innervate the heart, except in hagfish which have aneural hearts. Fish hearts lack sympathetic innervation. The level of vagal tone varies considerably, and is affected by many factors. In some fish the heart is essentially aneural (without vagal tone) during exercise and may resemble an isolated mammalian ventricle with increased venous return causing increased cardiac output. There are many mechanisms that could increase venous returns in exercising fish. β -adrenergic receptors have been located on the hearts of some fish, and changing levels of catecholamines may play a role in regulating cardiac activity. Changes in cardiac output in fish are normally associated with large changes in stroke volume and small changes in heart rate. (Auth.)

10505. Paulik, G. J., and D. S. Robson (College of Fisheries, Univ. of Washington, Seattle, Wash.). 1969. STATISTICAL CALCULATIONS FOR CHANGE-IN-RATIO ESTIMATORS OF POPULATION PARAMETERS. *J. Wildlife Mgmt.*, 33(1): 1-27.

A general unified approach is developed for estimating population abundance, productivity and exploitation rates, and survival characteristics from observed changes in population composition. This approach is applicable when a population can be classified into two categories and a change occurs in the relative abundance of the two types of animals. The two categories can be either natural or artificially constructed. Computation of variances for this family of estimators is described and construction of confidence intervals for population parameters explained. A technique is suggested for calculating the bias in an estimate of population size caused by certain types of deviations from underlying assumptions. Planning of field experiments and surveys to measure demographic characteristics of natural populations is discussed and charts are given for determining sample sizes required to estimate the abundance of a population within a specified percent error. Applications are illustrated by means of detailed numerical examples and a number of well-known population estimation techniques are shown to be special cases of the general formulae presented. (Authors)

10506. Timken, Richard L., and Bertin W. Anderson (Dept. of Zoology, Univ. of South Dakota, Vermillion, S.D.). 1969. FOOD HABITS OF COMMON MERGANSERS IN THE NORTHCENTRAL UNITED STATES. *J. Wildlife Mgmt.*, 33(1): 87-91.

A sample of 220 common mergansers (*Mergus merganser*) was collected from Minnesota, Nebraska and South Dakota during three years, 1966-1968. Observations of common merganser feeding behavior were made during the years 1963-1968. The sample of stomachs was obtained from fall and spring migrants, and winter residents. Sixty-seven stomachs (30%) of the total sample contained food items. Only 13% of these items could be considered game fish, the remainder were rough and forage fish. The common merganser in the Northcentral United States is not a serious predator of game fish, but is potentially a valuable game bird. The fall sample had significantly less stomachs with food items than the spring sample. (Authors)

10507. Klein, W.D., O.W. Olsen, and D.C. Bowden (Colorado Game, Fish and Parks Dept., Ft. Collins, Colo.). 1969. EFFECTS OF INTESTINAL FLUKE, *Crepidostomum farionis*, ON RAINBOW TROUT, *Salmo gairdnerii*. *Trans. Amer. Fish. Soc.*, 98(1): 1-6.

Rainbow trout artificially infected with *C. farionis* for at least eight months and controls were compared for length, weight, condition factor, hemoglobin, hematocrit, swimming endurance, and percentage body fat. Possible correlations between number of flukes and the indicator conditions were examined. Although the control trout were in slightly better physiological condition, results did not permit correlation with the absence or presence of *C. farionis*. Neither parasite damage to host tissue nor pathological response could be detected in the infected rainbow trout. However, hemoglobin and hematocrit levels in the test group were significantly lower than in the controls. (Authors)

10508. Normandeau, Donald A. (Dept. of Biology, St. Anselm's College, Manchester, N.H.). 1969. LIFE HISTORY AND ECOLOGY OF THE ROUND WHITEFISH *Prosopium cylindraceum* (Pallas), OF NEWFOUND LAKE, BRISTOL, NEW HAMPSHIRE. *Trans. Amer. Fish. Soc.*, 98(1): 7-13.

Life history and ecology of the round whitefish *Prosopium cylindraceum* (Pallas), of Newfoundland Lake, Bristol, New Hampshire have been studied. Field studies began the summer of 1959 and continued through December 1965. Newfoundland Lake fish attain sexual maturity in their fourth or fifth year of life. Sex ratio is 50:50. Spawning occurs, during the first three weeks of December, on a shallow rocky reef located between Pike's Point and Mayhew Island. Round whitefish average approximately 5,000 eggs (2,000-10,000) per female, correlated with age and size. Fertilized, water-hardened eggs, averaged 3.94 mm in diameter. The peak of hatching occurs during the last week of April, approximately 140 days from the time of fertilization at a water temperature of 36° F. (Auth.)

10509. Lewis, Stephen L. (Dept. of Zoology and Entomology, Montana State Univ., Bozeman, Mont.). 1969. PHYSICAL FACTORS INFLUENCING FISH POPULATIONS IN POOLS OF A TROUT STREAM. *Trans. Amer. Fish. Soc.*, 98(1): 14-19.

The relationship between fish populations and physical parameters of pools was studied in Little Prickly Pear Creek, Montana, during the summers of 1965 and 1966. The pools were mapped and their fish populations sampled. Surface area, volume, depth, current velocity, and cover accounted for 70 to 77% of the variation in numbers of trout over 6.9 inches total length. Most of the variation was the result of differences in current velocity and cover. Cover was the most important factor for brown trout, and current velocity for rainbow trout. The density of all trout per unit area of pool surface and cover increased significantly as current velocity became greater. Deep-slow pools with extensive cover had the most stable trout populations with brown trout showing greater stability than rainbow trout. The importance of cover to trout is discussed in terms of security and photonegative response and current velocity in terms of space-food relationships. (Auth.)

10510. Hunn, Joseph B. (Bur. of Sport Fisheries and Wildlife, Fish Control Lab., La Crosse, Wisc.). 1969. CHEMICAL COMPOSITION OF RAINBOW TROUT URINE FOLLOWING ACUTE HYPOXIC STRESS. Trans. Amer. Fish. Soc., 98(1): 20-22.

Rainbow trout (Salmo gairdnerii) were anesthetized with MS-222, catheterized, and introduced into urine collecting chambers. Twenty-four hours after introduction, a 4-hour accumulation of urine was collected to serve as the control. Water flow to the chambers was then discontinued for 30 minutes during which the oxygen content of the water exiting in the chamber dropped from 4.9 to 2.8 mg/l. Following this hypoxic stress fresh water was restored and accumulated urine samples were taken for analysis at 1, 4, and 20 hours post-hypoxic stress. Rainbow trout excrete abnormally high concentrations of Na, K, Mg, Cl, and inorganic PO₄ following hypoxia. (Auth.)

10511. Thomas, Allan E., Joseph W. Elliott, and Joe L. Banks (Bur. of Sport Fisheries and Wildlife, Salmon-Cultural Lab., Longview, Wash.). 1969. HEMATOLOGICAL AND CHEMICAL CHARACTERISTICS ASSOCIATED WITH PRECOCIOUS MALE CHINOOK SALMON FINGERLINGS. Trans. Amer. Fish. Soc., 98(1): 23-26.

Hematology, blood chemistry, glycogen levels, and plasma protein composition were measured on samples of female, male, and precocious male fingerlings, male yearlings, and 2-year-old jack chinook salmon. Precocious male fingerlings varied from immature fingerlings in levels of total plasma protein, cholesterol, and various plasma protein fractions, and were more similar in characteristics to jack salmon and yearlings. (Authors)

10512. Wagner, Harry H. (Oregon State Game Comm., Research Div., Oregon State Univ., Corvallis, Oreg.). 1969. EFFECT OF STOCKING LOCATION OF JUVENILE STEELHEAD TROUT, Salmo gairdnerii, ON ADULT CATCH. Trans. Amer. Fish. Soc., 98(1): 27-34.

Marked yearling hatchery-reared steelhead smolts were stocked at varying distances from tidewater in two Oregon coastal streams in April of 1964 and 1965 and the numbers of returning adults caught in the sport fishery were determined. Objectives of the study were to determine the preciseness of the homing mechanism in directing the returning adult fish to particular locations in a stream and the contribution to the sport fishery of adult fish of different release origins. Homing imprint was demonstrated to be influenced by stocking site within a stream. A contribution to the fishery of a particular release group was found to be dependent on a delay in upstream migration in the geographic area of stocking and on the fishing effort in the area. (Auth.)

10513. Albaugh, Douglas W. (State Biological Survey of Kansas, Univ. of Kansas, Lawrence, Kansas). 1969. SOURCES OF GROWTH VARIATION AMONG INDIVIDUAL BLACK BULLHEADS, Ictalurus melas, AND CHANNEL CATFISH, Ictalurus punctatus. Trans. Amer. Fish. Soc., 98(1): 35-44.

Fingerling black bullheads and subadult channel catfish were given various amounts of feed in different sections of earthen ponds subdivided with hardware cloth. A number of factors were investigated to determine their effects on gains in weight of individual fish. Both species made greater gains at higher rates of supplemental feeding, but gains were not directly proportional to the amount of feed used. Gains of male black bullheads relative to those of females varied with food supply. In groups having the least food, males and females made similar gains; in groups having the most food, the gains of males were far greater than those of females. Differences in initial weight had little effect on gains made by male bullheads, but gains by females were highly correlated with initial weight. Gains were more highly correlated with initial weight for channel catfish than for black bullheads. The relation of gain to sex in channel catfish was not determined. The relationship of gain to initial weight was a function of food supply in both species (correlation coefficients were low and often negative in groups having the least food; groups having the most food had high positive r-values). Gains were not significantly in-

fluenced by differences between ponds or among sections of ponds, by the number of times fish were handled, or by the particular combination of fins removed for marking purposes. Parasitism was slight, and proportional to size of fish. (Auth.)

10514. Warner, Kendall, and Angelo Incerpi (Maine Dept. of Inland Fisheries and Game, Ashland, Me.). 1969. CURRENT STATUS OF THE SALMON, Salmo salar, FISHERIES OF TWO FISH RIVER LAKES, MAINE. Trans. Amer. Fish. Soc., 98(1): 45-51.

Creel censuses were operated on Square Lake and Long Lake from 1964-1967 to evaluate the effects of a reduced length limit on salmon (Salmo salar) and the contributions of hatchery-reared salmon to the Long Lake fishery. With the reduced length limit, fishing success for salmon showed some fluctuations but generally improved. The 12-inch (305 mm) length limit was successful in increasing harvest of salmon at younger ages than formerly. Increases in mean size and growth rate of salmon occurred; these increases can probably be partly attributed to the reduced length limit and partly to the apparent increase in smelts. The Long Lake salmon fishery continued to be supported primarily by hatchery-reared salmon. Salmon stocked as spring yearlings provided higher recoveries to anglers than those stocked as fall fingerlings. (Authors)

10515. Eller, Lafayette L. (Fish-Pesticide Research Lab., Bur. of Sport Fish. and Wildlife, Columbia, Mo.). 1969. PATHOLOGY IN REDEAR SUNFISH EXPOSED TO HYDROTHOL 191. Trans. Amer. Fish. Soc., 98(1): 52-59.

Pathogenic effects of Hydrothol 191, mono-N, N-dimethylalkylamine salt of endothall (7-oxabicyclo [2. 2. 1] heptane-2-3-dicarboxylic acid) on redear sunfish (Lepomis microlophus) were investigated in ponds at Tishomingo, Oklahoma. Morphologic and systemic tissue alterations occurred in gill, liver, testis, and blood. Marked fusion of adjacent filaments of gills was observed in the early stages of contact with 0.3 ppm Hydrothol; however, after 14 days fish adjusted to the pesticide and the trend of tissue alteration was reversed with a gradual return to basic gill structure. Fish from the 0.3 ppm Hydrothol ponds showed marked liver damage; the damage was receding by the 56th day and was comparable to livers of control fish by the 112th day. Small and large ova-like hypertrophic cells appeared by the third day in the testes of 0.3 ppm-exposed fish by the 14th day and from the testes of 0.3 ppm-exposed fish by the 28th day. The hypertrophic cells of the testes remain unclassified and of unknown origin. Precipitated materials were observed in blood vessels of the posterior kidney at the 36th day in fish sampled from ponds treated with 0.5 ppm Hydrothol. (Auth.)

10516. Whitney, Richard R. (Fishery Oceanography Center, Bur. of Commercial Fisheries, La Jolla, Calif.). 1969. INFERENCES ON TUNA BEHAVIOR FROM DATA IN FISHERMEN'S LOGBOOKS. Trans. Amer. Fish. Soc., 98(1): 77-93.

Tuna seiner's logbooks representing 34,263 sets on tuna were examined to find indications of tuna behavior. The data were tabulated in four ways to show (1) number of purse seine sets made by time of day, (2) changes with time of day in percentage of sets that were successful in catching tuna, (3) changes with time of day in species composition of the catch, and (4) changes in school size with time of day. The frequency distribution of number of sets by time of day is nearly a normal curve which does not fit an assumption of equal availability of tuna at all hours. Greatest number of sets was at midday. The percentage of sets which was successful in catching tuna was higher at night than in the day. Also, success for yellowfin and skipjack was about 10% lower in early morning than the rest of the daylight period. Relatively few skipjack tuna were caught at night. Mixed species schools were even less frequent at night than expected on the basis of reduced frequency of skipjack, suggesting a tendency for separation of mixed species schools at night. Average size of tuna schools was the same at night as in the day except for schools of yellowfin tuna in the area south of 15° N, which were significantly smaller at night. Bluefin tuna schools increased in size from an average of 6 tons at 0700 hours to about 30 tons at 1900 hours, but the average daylight school was the same size as the night. Interpretations and inferences

from the data were attempted in terms of tuna behavior and behavior of fishermen with the objective of providing hypotheses that will be useful in designing studies of tuna behavior and of vessel operations. Among the hypotheses developed are: (1) Tuna make diurnal vertical movements which tend to bring them up toward the surface at midday and down into the deep waters at night. Skipjack may tend to go deeper than yellowfin tuna. (2) Decreased visibility of the purse seine at night accounts for the increased percentage of sets that are successful. Decreased activity of the fish might also explain the higher success. (3) Tuna schools maintain themselves at night by visual means, thanks to light from a number of possible sources. Some breakdown of schools may occur at twilight as a result of low light levels. (Auth.)

10517. Rose, Curt D., and W.W. Hassler (Dept. of Zoology, North Carolina State Univ., Raleigh, N. C.). 1969. APPLICATION OF SURVEY TECHNIQUES TO THE DOLPHIN, Coryphaena hippurus, FISHERY OF NORTH CAROLINA. Trans. Amer. Fish. Soc., 98(1): 94-103.

North Carolina's dolphin fishery was surveyed in 1961 and 1962 to evaluate its importance to the offshore sport-fishing industry, and to develop suitable and reliable techniques for sampling a marine sport-fishery. As a prelude to the investigation, characteristics of the prominent offshore charter-boat fishery are described. Duration of the sport-fishing season, species captured, fishing methods, and economical aspects of the fishery are discussed. In 1961, catch-forms, personal enumerations, and interviews with dockmasters were used to estimate the catch of party boats, private boats, and transient charter boats. Catch by these boats was approximately 3, 150 fish. The activity of resident offshore charter boats operating from the principal North Carolina ports was sampled by use of log books. Complete catch records were returned from 20% of the 90 resident boats that habitually frequented offshore waters. Ports were stratified for statistical treatment into five areas on the basis of proximity and similarity of fishing grounds. Monthly estimates of fishing pressure and catch were calculated for each area. Catch by resident charter boats was estimated to be about 35, 050 fish, or 92% of the total catch. Ninety-nine percent of this catch occurred during June through September. Merits of the offshore boat-day as a unit of fishing effort, and the inefficiencies inherent in the log-book survey are discussed. In 1962, the catch of party boats, private boats, and transient charter boats was estimated to be 3, 000 fish. Resident offshore charter boats were again stratified into the five areas described in the 1961 survey. A complete enumeration of fishing activity was obtained at Hatteras, North Carolina (Area IV). At Areas I, II, III, and V, log books were distributed to captains who kept reliable records of fishing effort and success. The remaining boats were surveyed by a stratified random-sampling design. Secondary stratification divided the fishing season into four 1-month intervals, thereby producing a total of 16 strata. The original frame consisted of 9, 028 total boat-days that were sampled to estimate fishing pressure and success by proportionally allocated postcards. In each stratum, total boat-days were divided into the following categories: offshore boat-days, bad-weather boat-days, and inshore or no-charter boat-days. Dolphin catch and its variance was determined for each stratum. Catch by resident charter boats was estimated to be 68, 007 fish (96% of total catch). Ninety-five percent confidence limits were 59, 790 and 76, 220 fish. Fishing pressure was approximately double that of 1961; catch per unit of effort remained essentially constant, resulting in a two-fold increase in catch. Seasonal catch of a typical resident charter boat was about 700 fish. Inclement weather curtailed offshore activity during approximately 10% of the fishing season. Rate of postcard return was 39% (882 of 2, 240 postcards originally distributed). Rate of return did not decrease as the fishing season progressed and did not appear to be a function of fishing effort. (Authors)

10518. Norris, David O. (Dept. of Biology, Univ. of Colorado, Boulder, Colo.). 1969. DEPRESSION OF GROWTH FOLLOWING RADIOTHYROIDECTOMY OF LARVAL CHINOOK SALMON AND STEELHEAD TROUT. Trans. Amer. Fish. Soc., 98(1): 104-106.

10519. Dawson, C.E. (Gulf Coast Research Lab., Ocean Springs, Miss.). 1969. THREE UNUSUAL CASES OF ABNORMAL COLORATION IN NORTHERN GULF OF MEXICO FLATFISHES. *Trans. Amer. Fish. Soc.*, 98(1): 106-108.
10520. Patten, B.G., and D.T. Rodman (Bur. of Commercial Fisheries, 2725 Montlake Blvd. East, Seattle, Wash.). 1969. REPRODUCTIVE BEHAVIOR OF NORTHERN SQUAWFISH, Ptychocheilus oregonensis. *Trans. Amer. Fish. Soc.*, 98(1): 108-111.
10521. Dahlberg, Michael D. (Marine Inst., Univ. of Georgia, Sapelo Island, Ga.). 1969. INCIDENCE OF THE ISOPOD, Olencira praegustator, AND COPEPOD, Lernaeenicus radiatus, IN THREE SPECIES AND HYBRID MENHADEN (Brevoortia) FROM THE FLORIDA COASTS, WITH FIVE NEW HOST RECORDS. *Trans. Amer. Fish. Soc.*, 98(1): 111-115.
10522. Wagner, Charles C. (The Pennsylvania State Univ., University, Park, Pa.). 1969. INCIDENCE OF LEECH INFESTATION ON BLACKNOSE DACE. *Trans. Amer. Fish. Soc.*, 98(1): 115-116.
10523. Priegel, Gordon R. (Dept. of Natural Resources, Madison, Wisc.). 1969. AGE AND RATE OF GROWTH OF THE FRESHWATER DRUM IN LAKE WINNEBAGO, WISCONSIN. *Trans. Amer. Fish. Soc.*, 98(1): 116-118.
10524. Mayhew, J.K. (Iowa Conservation Comm., Des Moines, Iowa). 1969. AGE AND GROWTH OF FLATHEAD CATFISH IN THE DES MOINES RIVER, IOWA. *Trans. Amer. Fish. Soc.*, 98(1): 118-121.
10525. Priegel, Gordon R. (Wisconsin Dept. Natural Resources, Madison, Wisc.). 1969. FOOD AND GROWTH OF YOUNG WALLEYES IN LAKE WINNEBAGO, WISCONSIN. *Trans. Amer. Fish. Soc.*, 98(1): 121-124.
10526. Frey, David G. 1967. RESERVOIR RESEARCH—OBJECTIVES AND PRACTICES WITH AN EXAMPLE FROM THE SOVIET UNION. In: *Reservoir Fishery Resources Symposium*. Publ. by Southern Div. Amer. Fish. Soc., pp. 26-36.
- The Soviet Union in 1961 had a total acreage of reservoirs about equal to that of the United States in 1965, with the largest reservoirs dwarfing the main stem reservoirs of the Missouri River. Projected expansion will eventually increase this acreage five-fold. Long-term studies on many of these reservoirs have revealed a common pattern of development, particularly during the first few years when flooded terrestrial soils dominate limnological processes. Opportunities for effective management are greater in man-controlled reservoirs than in nature-controlled lakes, but to acquire the wisdom necessary for such management will require the coordinated efforts of teams of investigators working on the same bodies of water. Two deficiencies in the United States are the relative lack of continuing intensive studies on particular reservoirs and the fact that many investigations wind up as processed reports, which can scarcely be considered part of the scientific literature. (Auth.)
10527. Middleton, J.B. 1967. CONTROL OF TEMPERATURES OF WATER DISCHARGED FROM A MULTIPLE-PURPOSE RESERVOIR. In: *Reservoir Fishery Resources Symposium*. Publ. by Southern Div. Amer. Fish. Soc., pp. 37-46.
- The control of temperatures of water discharged from multiple-purpose reservoirs is now accepted as one of the goals of the reservoir planner in those cases where this is necessary to avoid damage to downstream fisheries. The planning and design of DeGray Reservoir on the Caddo River in south-central Arkansas was coordinated with interested agencies from the earliest stages. From this planning has evolved a design of an intake structure which may be utilized to control, within a wide range, the elevations from which discharges are withdrawn. This feature, together with a downstream regulating dam, is expected to make practical the preservation of the existing downstream fishery. (Auth.)

10528. Bondurant, Donald C., and Robert H. Livesey. 1967. OPERATIONAL PROBLEMS ASSOCIATED WITH A BASIN RESERVOIR SYSTEM. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 47-55.

The Missouri River main stem reservoir system consists of six major reservoirs in tandem, controlling the drainage from approximately one-sixth the area of the 48 contiguous states and providing a combined storage capacity equal to more than three times the historical average annual flow at the downstream unit. Their operation as a system is complex, involving the transfer of water downstream from one unit to another and release of water from the system in accordance with inflow from various segments of the drainage and with the requirement for coordination to obtain maximum benefits for the primary functions of flood control, irrigation, hydroelectric power, and navigation. Within these requirements operations can frequently be adjusted to provide supplementary benefits; however, this must be accomplished on a cooperative basis with specialists in each function understanding and respecting the requirements of the other functions. (Authors)

10529. Wunderlich, W.O., and R.A. Elder. 1967. THE MECHANICS OF STRATIFIED FLOW IN RESERVOIRS. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 56-68.

This paper presents a discussion of the phenomena leading to temperature stratification in reservoirs. A stratification model is described which can be used for the approximate prediction of reservoir stratification and outflow water temperatures. The method is based on theoretical principles and observed behavior of stratified flows in reservoirs. A similar model can be used for the prediction of other water quality parameters, such as dissolved oxygen, if they are strongly influenced by the reservoir hydrodynamics. The paper presents an application of the method to a reservoir and shows the influence of an impoundment on water quality. The degree of accuracy which may be expected from the results is also developed. (Authors)

10530. Benoit, Richard J., John Cairns, Jr., and Charles W. Reimer. 1967. A LIMNOLOGICAL RECONNAISSANCE OF AN IMPOUNDMENT RECEIVING HEAVY METALS, WITH EMPHASIS ON DIATOMS AND FISH. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 69-79.

The purpose of this investigation was to determine the cause of the fish-kills which were occurring sporadically in the Upper Sacramento River below Keswick Reservoir. An attempt was made in 1955 and 1956 to locate and identify materials in the water that might be causing the kills. The study was divided into four phases: (1) general reconnaissance and biological survey, (2) diatometer (a device for suspending glass slides below the water surface to furnish a substrate for diatom growth) survey, (3) chemical survey, and (4) toxicity bioassays of certain waters and muds using salmon fingerlings as test organisms. A reconnaissance was made of the area from the Sacramento River just south of Redding, California, upstream to Lake Shasta, including Lakes Redding and Keswick. Twenty-one sampling stations were set up: three below Keswick Dam in Lake Redding and in the Sacramento River below Redding, eleven in Keswick Reservoir, and seven on tributaries flowing into Keswick Reservoir. The results of the biological survey indicated that the upper tributaries of Keswick Lake had a typical variety of flora and fauna but that one of the lower tributaries, Spring Creek and its two branches, Slickrock and Boulder Creeks, were severely degraded by acid mine drainage. The degrading influence of Spring Creek could be detected at the lower Keswick stations as well as at those in upper Lake Redding. The lower Lake Redding stations and the Sacramento River station downstream had normal biotas. The diatometer survey confirmed these results and added some important details. Diatometer studies during a freshet showed a pulse of increased damage to the diatom flora in lower Keswick Lake and the upper portion of Lake Redding. The chemical survey revealed conditions consistent with the results of the biological and diatometer studies. The waters of Spring Creek were found to have a very low pH and to contain high concentrations of iron, copper, and zinc. The delta muds of

Spring Creek in Keswick Lake also contained quantities of these metals, and large quantities of hydrous iron oxides were sedimented in Keswick Lake below the entrance of Spring Creek. The results of the bioassays showed that both Spring Creek water and delta sediments were toxic. Analysis of various flow conditions indicated that at certain times toxic conditions could develop in lower Keswick Lake and upper Lake Redding because of the acid waters and heavy metals discharged from Spring Creek. While not included in this study it is worth noting that the Bureau of Reclamation has installed a dam on Spring Creek to control its flow. (Authors)

10531. Lawrence, J.M. 1967. DYNAMICS OF PHYSICOCHEMISTRY IN A LARGE RESERVOIR. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 100-113.

Thermal and chemical stratification occurred in all inundated areas of Lake Eufaula during summer months of 1965 and 1966, but was broken at least four times each year by cool-rainy weather. Dye studies indicated existence of main channel density currents during stratified conditions. Iron concentrations in water varied with stratification and often appeared to be in particulate form. Calcium plus magnesium contents of these waters averaged 5.5 ppm, which places this lake in the very soft water category. Total carbon content averaged 13 ppm in 1965 and 11 ppm in 1966. (Auth.)

10532. Boyd, Claude E. 1967. SOME ASPECTS OF AQUATIC PLANT ECOLOGY. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 114-129.

Nonplankton algae and aquatic angiosperms contain large amounts of macro-nutrient cations while phytoplankton samples are lower in these elements. Nitrogen and sulfur levels in phytoplankton usually exceed values for these nutrients in macrophytes. Substantial levels of micronutrients are found in most aquatic species. Values for productivity rates and vegetative yields in pure stands of macrophytes often equal or exceed those for non-aquatic herbaceous vegetation. Quantities of minerals contained in standing crops of aquatic plants represent a large drain on available nutrient supplies in many lakes. Ecological data indicate that distribution and growth of many macrophytic species are related to characteristics of the substratum. Rooted angiosperms have the necessary morphological and physiological adaptations for mineral absorption via the roots, but the role of hydrosol nutrients in sustaining plant growth needs critical experimental evaluation. Apparent shortcomings in techniques of estimating aquatic fertility with bottom-soil and water chemical analyses are discussed. (Auth.)

10533. Irwin, William H., James M. Symons, and Gordon G. Robeck. 1967. WATER QUALITY IN IMPOUNDMENTS AND MODIFICATIONS FROM DESTRATIFICATION. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 130-152.

The success of projects that propose to regulate streamflow for improving water quality depends on a source of good quality impounded water than can be used for downstream flow control. Research was initiated to develop engineering methods that would overcome or prevent water quality deterioration that occurs during storage. This paper describes some of the reactions that take place in reservoirs and lakes and it also presents data to demonstrate the effectiveness of artificial destratification as a means of maintaining good quality water. Impounded water can become thermally stratified. If this occurs, the lower waters in the impoundment are effectively sealed from the atmosphere by the light-warm water floating on the surface. Because atmospheric reaeration is prevented, the naturally occurring oxygen-demanding reactions reduce the dissolved oxygen (DO) concentration to zero. Under anaerobic conditions, the occurrence of reducing reactions, such as sulfide production and iron and manganese dissolution, can bring about water quality degradation. Because very little energy is required per unit volume to lift the cooler water to the surface of a stratified impoundment, an attempt was made to artificially destratify two small lakes in northern Kentucky, one 2,900 ac-ft and the other 4,600 ac-ft. In 1965 a raft-mounted pump was used, while in 1966 a diffused

air system was used. The data show that considerable improvement in water quality resulted from the mixing. Nearly uniform water temperatures, better vertical distribution of the DO, decreases in the concentration of reduced materials, and prevention of reduction reactions from continuing all resulted from the destratification operation. These improvements in the quality of this water made it a better source for streamflow regulation and improved its recreational potential. (Authors)

10534. Nielson, Lyman J. 1967. EVALUATION OF PRE-IMPOUNDMENT CONDITIONS FOR PREDICTION OF STORED WATER QUALITY. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 153-168.

Dam construction and possible use of stored water as a tool for water quality control and downstream resource management has resulted in a need for predicting future quality of impounded water. Methods for making such forecasts of water temperature and dissolved oxygen concentration are presented and problems connected with their use discussed. Although present prediction techniques are imperfect, it is suggested that future knowledge may result in refinements permitting improved accuracy. (Auth.)

10535. Nelson, D.J. 1967. ECOLOGICAL BEHAVIOR OF RADIONUCLIDES IN THE CLINCH AND TENNESSEE RIVERS. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 169-187.

Biological investigations in connection with the Clinch River Study sought to determine the uptake and turnover of radionuclides in biota, the effect of biota in redistributing radioactivity, and the effect of ionizing radiation on aquatic organisms. Conventional fish tagging studies were conducted with the Clinch River fish, and, in addition, movements of smallmouth buffalo were studied by use of radionuclides deposited in their scales. Scale radioactivity, detected by autoradiography, provided a continuum of information with respect to the movement of fish into and out of areas contaminated with radionuclides. The white crappie was selected for intensive study because the tagging survey showed that it did not migrate far in the river, and therefore its exposure to radioactive waste releases could be estimated more closely. A good agreement was observed between the specific activity of ^{90}Sr in water and fish tissue which showed that ^{90}Sr concentrations in fish may be predicted for constant releases of ^{90}Sr to the river. Freshwater clams were also good indicators for ^{90}Sr in river water. Clams are relatively immobile on the river bottom, and the concentration of ^{90}Sr in their shells was directly proportional to the concentration of ^{90}Sr in river water to which they were exposed. The effects of radiation on aquatic organisms were studied by examination of the salivary gland chromosomes of *Chironomus tentans* larvae in an effort to detect chromosomal aberrations which might be attributed to radiation exposures. Induced aberrations were observed, but these were eliminated from the population by natural selection. Hence, no permanent radiation damage to the population has occurred. Estimates of radionuclides incorporated in the biomass of fish, clams, and insects living in the river suggest that activities of aquatic organisms are not important as vectors of radioactivity nor will organisms contain a significant quantity of radioactivity. These results suggest that the greatest hazard to man from a contaminated environment will result from the consumption of contaminated food and water. (Auth.)

10536. Wright, John C. 1967. EFFECT OF IMPOUNDMENTS ON PRODUCTIVITY, WATER CHEMISTRY, AND HEAT BUDGETS OF RIVERS. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 188-199.

The practice of designing large deep multiple-purpose dams with deep-water penstocks appears to have many deleterious effects. Water is released during the irrigation season with a higher salinity than would be obtained from surface water withdrawal. Essential nutrients are lost from such reservoirs, thus tending to deplete the productive capacity of the reservoir and at the same time cause eutrophication downstream. Evaporative loss is increased as a result of storing warm incoming water and releasing cold hypolimnial water. Water too cold for satisfactory fish growth may also be released under certain conditions. Water with

dissolved oxygen concentrations too low to handle downstream BOD may be released. In extreme cases hydrogen sulfide-laden water has been discharged, resulting in downstream fish-kills. The interrelationships between fish populations and zooplankton production in reservoirs should be more carefully investigated. Since bottom fauna production is usually negligible in such reservoirs, excessive predation pressure on large zooplankton forms by fish may be responsible, in part, for decreased fish production. (Auth.)

10537. Verduin, Jacob. 1967. RESERVOIR MANAGEMENT PROBLEMS CREATED BY INCREASED PHOSPHORUS LEVELS OF SURFACE WATERS. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 200-206.

Phosphorus levels have increased, in fresh water of the U. S. A., by about four-fold during the past twenty years. Present levels are in the vicinity of 100-200 $\mu\text{g/liter}$, and are about ten-fold higher than the levels considered sufficient to produce nuisance concentrations of algae. Nitrogen:Phosphorus ratios have dropped, in Lake Erie, from values of 35 to about 9, indicating a more nearly balanced N:P supply. Such high nutrient levels are likely to create increased problems for reservoir management, foul odors and tastes in drinking water, large deposits of algae on beaches, fish and benthos mortality, etc. It is suggested that lagoons be constructed, as an adjunct to sewage treatment plants, to reduce nutrient levels by natural cropping before releasing sewage effluents to our streams and lakes. (Auth.)

10538. O'Connor, Joel S., and Bernard C. Patten. 1967. MATHEMATICAL MODELS OF PLANKTON PRODUCTIVITY. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 207-228.

Published mathematical models of plankton productivity in several marine and freshwater environments are reviewed. Existing models are inevitably lacking somewhat in generality, realism, or precision — each of which is a desirable attribute of models. An attempt is made to categorize plankton models by these attributes to emphasize that the type of utility of each model is determined somewhat by its degrees of precision, realism, and generality. A graphic representation of the references containing plankton models illustrates the evolutionary modifications and extensions of earlier models if the later reference explicitly acknowledges antecedent models by citing them. (Authors)

10539. Swingle, H. S., and W. E. Swingle. 1967. PROBLEMS IN DYNAMICS OF FISH POPULATIONS IN RESERVOIRS. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 229-243.

Reservoir surveys by rotenone sampling over the period 1949 to 1966 are in the process of being summarized. Some of the problems and the population dynamics of several species are discussed, with suggestions for further study. Regression equations relating F/C to A_T , S_F and Y/C in pond populations failed to fit the population estimates by rotenone sampling except in cove areas where block nets were used and rotenone was pumped through perforated hoses that distributed the chemical from top to bottom of the waters. Population dynamics appeared essentially similar in ponds and reservoirs. A multiple-regression equation developed for estimating the standing crop of bluegill-bass in fertilized ponds appeared to estimate the standing crops in certain reservoirs only because of compensating errors. Measurements that appear necessary for computing more accurate population estimations are discussed. Rotenone sampling gave no evidence of cycles in species abundance even when they were known to occur. It is suggested that standard length-weight tables be compiled for the entire Southeast so that a standard relative condition factor could be computed for use in this area. The dynamics in reservoirs of largemouth bass, spotted bass and crappie are discussed. (Authors)

10540. Hayne, Don W., Gordon E. Hall, and Hudson M. Nichols. 1967. AN EVALUATION OF COVE SAMPLING OF FISH POPULATIONS IN DOUGLAS RESERVOIR, TENNESSEE. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 244-297.

A multi-agency cooperative study was organized by the Reservoir Committee, Southern Division, AFS. After rotenone treatment of a 115-acre arm of Douglas Reservoir, fish recovered in coves were compared as to number and weight with those from the open water. Results varied with species and age of fish, but for total weight the coves appeared to fairly represent the whole arm. (Authors)

10541. Jenkins, Robert M. 1967. THE INFLUENCE OF SOME ENVIRONMENTAL FACTORS ON STANDING CROP AND HARVEST OF FISHES IN U.S. RESERVOIRS. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 298-321.

The effects of nine environmental factors on standing crops of fish, as measured by recovery following rotenone treatment, and on sport and commercial fish harvests in U.S. reservoirs were explored by multiple regression analyses. The mean standing crop in 127 reservoirs was 186 pounds per acre; mean sport fish harvest in 121 reservoirs, 22.6 pounds per acre; mean commercial harvest in 46 reservoirs, 10.2 pounds per acre. Environmental factors considered were: reservoir area, mean depth, total dissolved solids, storage ratio, shore development, age, water level fluctuation, outlet depth, and growing season. Most of the multiple regressions accounted for less than 50% of the total variability in standing crop or harvest, but significance levels were high. Environmental factors which appear to exert greatest positive influence are: dissolved solids on both standing crop and sport fish harvest; age of reservoir on clupeid standing crop and commercial harvest; storage ratio on sport harvest; shore development on standing crop and sport harvest. Factors of greatest negative influence are: age of reservoir on sport harvest; storage ratio on clupeid standing crop and commercial harvest; area on sport harvest; mean depth and shore development on commercial harvest. Multiple regressions of greatest apparent predictive utility are: a) standing crop on dissolved solids divided by mean depth; b) standing crop on dissolved solids, shore development, and storage ratio; c) sport harvest on dissolved solids, growing season, age, area, and shore development; and d) commercial harvest on growing season, mean depth, storage ratio, age, and fluctuation. (Auth.)

10542. Neel, Joe Kendall. 1967. RESERVOIR EUTROPHICATION AND DYSTROPHICATION FOLLOWING IMPOUNDMENT. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 322-332.

Commonly accepted concepts of productivity controls in inland waters are reviewed and their modifications by reservoirs discussed. Various factors contributing to early reservoir enrichment and productivity decline are related to reservoir characters and peculiarities. Type and size of reservoir, initial operation, pretreatment of basin, nature of inundated soils, withdrawal of bottom waters, and isolation of flow segments are included. Factors associated with early autotrophic maxima and minima in Missouri River main stem reservoirs indicate that phosphorus and nitrogen build-up was prerequisite to maximum growth, but that exhaustion of other nutrients led to decline after nitrogen and phosphorus ceased to be limiting factors. Phosphorus and nitrogen concentration increased with plankton declines and decreased with plankton growth. During early impoundment, plankton often reached greater densities below reservoirs than in them. (Auth.)

10543. Eley, Rex L., Neil E. Carter, and Troy C. Dorris. 1967. PHYSICO-CHEMICAL LIMNOLOGY AND RELATED FISH DISTRIBUTION OF KEYSTONE RESERVOIR. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 333-357.

Physicochemical parameters and vertical fish distribution were determined monthly at four open-water stations along the Cimarron arm of Keystone Reservoir in north-central Oklahoma from September 1965 through August 1966. Occasional measurements of physicochemical conditions at several points on the Arkansas arm and below Keystone Dam were made. Salt-heavy water of the Cimarron River formed an underflowing density current under the lighter Arkansas River water. Dense bottom water increased in volume when discharges were made

through the dam from the epilimnion. Stable chemical stratification prevented mixing except during a flood in September 1965. Chemical stratification was most stable during the winter and least stable during the summer. Thermal stratification was most stable in the summer and least stable during the fall and winter when inverse thermal stratification occurred. Stagnation produced lethal conditions for less tolerant fish species, such as gizzard shad, in July 1966. When hypolimnetic water was released to decrease the stability of stratification, fish were killed for about 1 mile in the tailwaters. Concentrations of ammonia as high as 12.4 mg/l probably caused the fish-kill. Energy dissipators in the sluice gates aerated the cool, anoxic bottom water, and dissolved oxygen was higher 50 yards below the dam than in the surface water of the reservoir. Draining of the salt-heavy hypolimnion allowed mixing to occur to a greater depth and decreased stagnation. Average turbidity decreased from 45 to 20 Jackson units and average temperature decreased from 17.1 to 15.4° C as the water moved through the reservoir in 1965-66. Temperature apparently affected vertical fish distribution more than any other measured physiochemical factor. However, drum distribution appeared to be dependent on factors other than those measured. Oxygen content lower than 2 mg/l limited fish distribution. As oxygen depletion increased during spring and summer, fishes moved to aerated water above the chemocline. (Authors)

10544. Benson, N.G., and B.C. Cowell. 1967. THE ENVIRONMENT AND PLANKTON DENSITY IN MISSOURI RIVER RESERVOIRS. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 358-373.

The environments of the six Missouri River main stem reservoirs are described in terms of morphometry, chemistry, water exchange rate, temperature, and turbidity. The reservoir system has a capacity, at annual flood control pool, of $57.6 \times 10^9 \text{ M}^3$ and an area of 463,000 ha. Phytoplankton densities at Williston, Bismarck, and Yankton are briefly described. Diatoms dominate the phytoplankton, and nannoplankton (0.074 mm) compose 84.3% of the volume. Net phytoplankton and nannoplankton volume curves differ in seasonal peaks. A one-year loss from Lewis and Clark Lake was 9,058 metric tons and was partially related to discharge rates; most loss was during the spring and summer. Dense periphyton growth developed on submerged trees in Lewis and Clark Lake and reached 6×10^6 cells/cm² in May. Water-level fluctuation reduced periphyton density on trees in Lake Francis Case. Cladocerans and copepods showed little vertical or horizontal stratification in Lewis and Clark Lake. Peaks were in late spring and early fall and winter. Discharge biomass of cladocerans and copepods was 12,619 metric tons from November 18, 1963 to November 17, 1964 and 29,752 the following year. The second year had a strong winter pulse of Bosmina and higher spring densities of cladocerans and copepods. In Lake Francis Case, cladocerans and copepods were abundant at all depths during July 1966. Protected areas in Oahe Reservoir had higher zooplankton densities than unprotected areas. Turbidity appears to be the strongest limiting factor to plankton abundance in the system. Standing crop measurements of plankton in reservoirs have limited value unless they are related to loss, indigenous production, and replenishment from upstream. (Authors)

10545. Nelson, W.R., R.E. Siefert, and D.V. Swedberg. 1967. STUDIES OF THE EARLY LIFE HISTORY OF RESERVOIR FISHES. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 374-385.

A quantitative sampling program to study early life history of reservoir fishes is described. The 27-foot trawl and the 100-foot bag seine are standard sampling gears and supplemental gears are the 16-foot trawl and 0.5-m plankton nets. Biweekly samples are collected from (1) exposed beach, (2) protected beach, (3) protected embayment, (4) inundated flood plain, and (5) former river channel. Species considered are sauger, Stizostedion canadense; white crappie, Pomoxis annularis; freshwater drum, Apodinotus grunniens; and yellow perch, Perca flavescens. Methods for determining spawning, growth, food habits, mortality, and year-class strength are described. Estimation of first-year growth is difficult because of (1) gear avoidance, (2) movement, and (3) variation in time and length of spawning period. To minimize errors, sampling stations were selected to

represent major habitat types and catch by gears was combined. Growth of species with a short spawning period can be described by linear regression. No suitable method is available for fish with an extended spawning period. Catch-effort indices are used to estimate mortality rates and year-class strength. Determination of mortality is difficult because of: (1) variability in catch rates by season; (2) ability of fish to escape gear with increase in size; and (3) fish movement. Drum mortality rates can be calculated by using lengths without regard to date. The methods can be used to estimate year-class strength since the same methods are used annually and errors are random, not accumulative, and not systematic. (Authors)

10546. Houser, Alfred, and Horace E. Bryant. 1967. SAMPLING RESERVOIR FISH POPULATIONS USING MIDWATER TRAWLS. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 391-404.

A midwater trawling technique and an analytical procedure for deriving a population estimate from trawl catches were developed and tested in 1965. A population estimate was obtained for O-age threadfin shad Dorosoma petenense (Genther) in Bull Shoals Reservoir in 1965. After extensive modifications in the gear, similar estimates were repeated in July and September 1966. Monthly population estimates were conducted on Beaver Reservoir during the same period. Estimates were obtained for threadfin shad and gizzard shad. These estimates reveal dramatic changes in population size during the first summer of life. Cove rotenone samples conducted during the same period reveal that older gizzard shad and possibly the O-age are much more abundant in coves than in open water trawl samples. Standing crop estimates showed that threadfin shad were much more homogeneously distributed and were almost equally common in both types of samples. The comparison between midwater trawl samples and cove rotenone samples illustrates that the two methods may yield dissimilar results and that cove rotenone samples from deep reservoirs may not accurately represent the total population. (Authors)

10547. Zeller, Howard D., and Herbert N. Wyatt. 1967. SELECTIVE SHAD REMOVAL IN SOUTHERN RESERVOIRS. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 405-414.

Selective fish-kills of gizzard shad using dilute rotenone concentrations are evaluated as a fisheries management technique for southern reservoirs. Data on the results of rotenone treatment for gizzard shad control, along with duration of results, evaluation of fish populations after treatment, and costs of selective shad removal, are discussed and evaluated. Creel census and fish population data are presented for Lake Blackshear, Georgia, before and after selective shad removal. Increase in fishing success three years after treatment is demonstrated with creel census data, and the effect on growth and reproduction for largemouth bass, bluegill, and other game fish species is also presented. Stocking programs are evaluated following shad removal with regard to the success of this management technique. It was concluded from the data available from the southern states utilizing this technique in reservoirs that fishing success was improved for three to five years following treatment for selective removal of gizzard shad. Most states utilizing this management technique concurred that shad removal was considered to be feasible when gizzard shad made up over 50% of the total fish population by weight. (Authors)

10548. Raleigh, Robert F., and Wesley J. Ebel. 1967. EFFECT OF BROWNLEE RESERVOIR ON MIGRATIONS OF ANADROMOUS SALMONIDS. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 415-443.

Spawning migrations of adult chinook salmon (Oncorhynchus tshawytscha) were followed as they passed through the impoundments; their success in reaching the spawning grounds was compared with that of fish transported around the reservoir and released in the river above. Spawning success, as evaluated by data on egg retention, was also compared between groups of salmon that used the spawning grounds before and after construction of Brownlee Dam in 1958. On this basis

Brownlee Reservoir evidently has little influence on spawning migrations of chinook salmon. Seaward migrations of juvenile native chinook salmon and of hatchery-reared chinook salmon, coho salmon (*Oncorhynchus kisutch*), and sockeye salmon, were also studied as the fish passed through the impoundment area. Concurrent limnological studies revealed that physical and chemical factors restrict vertical distribution of migrants in the reservoir from early July through September. Surface temperatures increase and low values of dissolved oxygen move slowly upward from the bottom throughout the summer; these conditions limit the migrants to a narrow band of habitable water. Juvenile salmonids are almost absent from reservoir areas where zones of high temperature and low oxygen overlap. Except for a short period in late summer when a growth check was formed on the scales, growth rate of juveniles in the reservoir was good. Survival was extremely poor, however, for those smolts that did not complete their migration the first year. Reservoir and river conditions were separated in 1963 by a sharp line at the upper end of the reservoir. Most of the juvenile migrants accumulated above the line in the river water for 6 weeks, until conditions changed and the separation line disappeared. Success of smolt migration was generally correlated with conditions of water flow through the reservoir. Well-oriented downstream currents depend not only upon water flows into and out of the reservoir, but also upon draw down and pool length. (Authors)

10549. Wilkins, Price, Leon Kirkland, and Andrew Hulsey. 1967. THE MANAGEMENT OF TROUT FISHERIES IN RESERVOIRS HAVING A SELF-SUSTAINING WARM WATER FISHERY. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 444-452.

A national survey indicated that management of trout in reservoirs with self-sustaining warm-water fish populations for production of trout is an important segment of the fisheries program in thirty-one of forty-seven responding states. Most of these trout fisheries originated and are maintained from stocked fish. Previously established criteria of 70° F maximum temperature and 3 ppm minimum dissolved oxygen for determining suitability of reservoirs for rainbow and brown trout were verified. Two basic situations that produce water of this quality are discussed. Rainbow trout is the most extensively used species in these programs but brown and brook trout have given good results under certain conditions. A majority of respondents preferred fall and winter stockings of fish larger than six inches in length for maintenance of these fisheries. An invertebrate diet produced rapid growth of trout up to approximately 12-14 inches in length. Where a pelagic, plankton feeding forage species was available, fish over 12-14 inches grew at a more rapid rate, up to one inch per month, and reached a larger average size. Trout stocked in areas of reservoirs maintaining suitable environmental conditions did not migrate extensively except to enter adjacent tributary streams immediately following stocking and on spawning "runs". When stocked in areas not suitable during critical summer periods, trout sought out a suitable environment by migrating as much as thirty miles. A recovery rate of 50% by weight is suggested by the authors to justify stocking. The consensus of the survey was that costs of maintaining these fisheries were justified. (Authors)

10550. Ball, Orville P., Jr. 1967. RECREATIONAL FISHERY MANAGEMENT. A CASE STUDY OF A RESERVOIR. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 453-466.

Murray Reservoir, a 140-165 surface acre impoundment located within the city limits of San Diego, is a part of the water supply system. It is relatively unproductive of warm water fish largely because of the chemical nature of the water and the nature of the reservoir basin. Beginning in 1959, catchable trout were superimposed from November through June upon the inadequate existing fishery. Water conditions dictated the length of the "trout season." Response vaulted from 7,000 angler-use days per year as a warm water fishery prior to 1959, to over 50,000 angler-use days as a combination trout-warm water fishery. The trout averaged one-half pound each and were purchased by the city. An average weekly inventory was maintained by stocking to sustain approximately a 1.9 trout-per-adult

angler catch rate on each open day. Angling success represented economic feasibility under the permit fees system required of patrons, as well as satisfactory quality of fishing. Harvest rate exceeded 90% of available trout. The concept of total management of a recreational fishery program included special events, public opinion surveys, and special services for patrons in order to increase interest and satisfaction. The economics of the reservoir recreation activities is related to revenue from permit fees, operating costs, and a policy mandate to maintain a self-sustaining program financially. Patron satisfaction becomes more imperative when angler-use fees are involved. A total of 24 factors were isolated that affect public usage of Murray Reservoir. (Auth.)

10551. Greenwood, M.R., and M.F. Boussu. 1967. EFFICIENT FISHING SYSTEMS - POTENTIAL FOR INCREASING EFFECTIVENESS OF COMMERCIAL FISHERIES IN RESERVOIR MANAGEMENT AND UTILIZATION. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 467-476.

Possible utilization of fish stocks, presently of little or no value to sport or commercial fishermen, for processing into industrial products, is discussed. It is noted that utilization of these fish stocks would likely enhance the effectiveness of commercial fishing in reservoir management as well as contribute to the economy of reservoir communities. Instances of successful processing of freshwater fish into meal and pet foods are cited, and some criteria for successful operations are noted. Cost estimates, production requirements, fishing gears, vessels, and fish handling systems are reviewed. (Authors)

10552. Pfitzer, Donald W. 1967. EVALUATION OF TAILWATER FISHERY RESOURCES RESULTING FROM HIGH DAMS. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 477-488.

High dams have caused great ecological changes in streams. More than 260 dams have been constructed by public agencies in the southeastern United States. Tailwater areas can provide important habitat for recreational fishing. Most warmwater tailwaters produce very valuable fisheries without management. This study discusses the cold tailwaters which may or may not produce a good trout fishery. Information was compiled on 32 projects, 27 predominantly trout, with a total river length of 461 miles. It was found that dam design and operation have significant effects on quantity and quality of the fishery. Structural modification of dams has been employed to enhance downstream fisheries. After a project is completed, changes in operation can improve a tailwater fishery. Stocking is currently the most flexible tool for tailwater management. In four projects alone, more than 160 miles of recreationally important streams have been modified to such an extent that the fishery values have been lost. Advanced planning in design and operation of hydroelectric and flood control projects must take into account the value of tailwater areas if we are to realize the full potential of the resource. (Auth.)

10553. Schueler, Robert L., and John K. Sullivan. 1967. QUANTIFYING CURRENT AND POTENTIAL COMMERCIAL FISHERY HABITAT AND PRODUCTION ON THE INLAND WATERS OF MIDWEST U.S. EXCLUSIVE OF THE GREAT LAKES. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 489-498.

River, impoundment, and natural lake habitats in midwestern U.S. are analyzed by major river basins and productivity classes with respect to commercial fisheries production potential. Comparison is made with actual production, and factors limiting utilization in specific regions or of certain species are discussed. The combined annual commercial fishing production potential of the Upper Mississippi, Ohio, Missouri, Arkansas-White-Red, Tennessee, Lower Mississippi, and Red River of the North Basins is estimated at 458 million pounds of which 54.6 million pounds, or 11.9%, was actually harvested in 1965. (Authors)

10554. Brittan, Martin R., and Andrew H. Trice. 1967. CALIFORNIA'S MERCED RIVER PROJECT: A CASE HISTORY OF STATE AND LOCAL COOPERATION IN FISHERY AND RECREATIONAL IMPROVEMENT. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 499-516.

The Merced Irrigation District in central California is presently completing a project to enlarge its Exchequer Dam and Powerhouse and to build a new after-bay dam, McSwain. California's Davis-Grunsky Act is designed to give financial support to public agencies for water projects if they will make the waters and surrounding land area available for recreation and fishery and wildlife purposes. The Merced Irrigation District has applied for a financial grant under the Act, as have many other agencies. The Act is designed to give construction and facilities grants, the former for the parts of construction costs allocated to recreation and fish and wildlife, the latter to cover initial water supply and sanitary facilities. The physical details of the project are outlined. Reservoir recreation and fishing potentials for the two reservoirs are analyzed, as is river-associated recreation. The recreation portion of the construction grant for this project is based on total recreational use of the reservoir, and reservoir fishery use is herein included. The fishery portion of the construction grant is based on rehabilitation of the salmon run and the fishery it will support, especially in terms of the Merced River contribution and value to the ocean commercial and sport fishery. A total grant has been made of \$6,500,000, of which the fishery enhancement grant constitutes \$2,146,000, against total construction costs of \$36,000,000. (Authors)

10555. Applegate, Richard L., and James W. Mullan. 1967. STANDING CROPS OF DISSOLVED ORGANIC MATTER, PLANKTON, AND SESTON IN A NEW AND AN OLD OZARK RESERVOIR. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 517-530.

Mean annual standing crop estimates (June 1963-August 1966) of dissolved organic matter, plankton, and seston were similar in 0-3 year-old Beaver Reservoir and 12-15 year-old Bull Shoals Reservoir located in the Arkansas-Missouri Ozarks. Differences between reservoirs pertained primarily to seasonal cycles of abundance. Seasonal standing crop estimates of net phytoplankton and zooplankton in Bull Shoals Reservoir showed a unimodal curve with highest densities in the spring. Beaver Reservoir, by contrast, displayed a bimodal pattern with maximum zooplankton densities occurring in the spring and late summer-fall and highest net phytoplankton densities in the summer-fall. Increases in the amount of dissolved organic matter followed the annual April-May plankton pulses in Bull Shoals Reservoir. Dissolved organic matter concentration has trended downward in Beaver Reservoir since impoundment. (Authors)

10556. Ferguson, Denzel E. 1967. CHARACTERISTICS AND SIGNIFICANCE OF RESISTANCE TO INSECTICIDES IN FISHES. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 531-536.

Several species of freshwater fishes from cotton-producing areas of the Mississippi Delta region exhibit resistance to a variety of pesticides. The rate at which resistance evolves, the nature of genetic mechanisms responsible for resistance, and the effects of resistant populations upon natural ecosystems pose challenging problems to fishery biologists. Recent findings suggest that toleration of massive amounts of pesticide residues in tissues of resistant fish represents a hazard to potential consumers, including man. (Auth.)

10557. Tennant, Donald L., Robert E. Thomas, and Joe Gray. 1967. PHYSICO-CHEMICAL LIMNOLOGY OF FOUR RESERVOIRS IN SOUTHWEST NEBRASKA. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 537-540.

Physicochemical data from four reservoirs in Nebraska taken within a 30-hour period in August, revealed moderate thermal stratification, closely associated in two reservoirs with the functioning low-level outlet. The reservoirs with thermoclines exhibited greater temperature ranges and contained cooler waters than did

reservoirs without thermoclines. The distribution of fish as detected on sonar often revealed the presence and location of a thermocline prior to physical or chemical data verification. Without exception, the larger the reservoir and the lower the outlet, the better the reservoir fishery. Downstream fisheries ranked the same with one exception. (Authors)

10558. Cowell, Bruce C., and Patrick L. Hudson. 1967. SOME ENVIRONMENTAL FACTORS INFLUENCING BENTHIC INVERTEBRATES IN TWO MISSOURI RIVER RESERVOIRS. In: Reservoir Fishery Resources Symposium. Publ. by Southern Div. Amer. Fish. Soc., pp. 541-555.

Variations in morphometry and water management practices are responsible for differences in the benthic invertebrate populations of the Missouri River reservoirs. In Lewis and Clark Lake, a relatively shallow impoundment, water temperature, behavior of the ovipositing females, and depth-related factors regulate the distribution and abundance of *Hexagenia* nymphs which dominate the biomass. Water-level fluctuations and the accompanying wind and wave action on the bottom are responsible for small *Hexagenia* populations in Lake Francis Case. Despite the complete exposure of the littoral zone, chironomids are 3-fold more abundant in Lake Francis Case than in Lewis and Clark Lake. Evidence of migration of *Hexagenia* nymphs and chironomid larvae was observed. *Hexagenia* nymphs migrate in response to water temperature and population density, and chironomids migrate with water-level fluctuations. Migration in the Missouri River reservoirs which are characterized by high water discharge rates can produce a significant loss of benthic invertebrates through the turbines. In 1964 we estimated the loss from Lewis and Clark Lake as 44 metric tons: 24 tons of *Hexagenia* nymphs and 20 tons of chironomid and certopogonid larvae. High populations of benthic invertebrates were found on periphyton substrates of submerged trees and higher aquatic plants. The density of these organisms on submerged trees was correlated with pigment concentration. (Authors)

10559. Oehmcke, Arthur A., and Gilbert Radonski. 1969. TROUT STOCKING: RESULTS WANTED. Wisconsin Conservation Bull., 34(1): 14-15.

Wisconsin streams now are classified on the basis of their potential for trout. The object is to limit stocking to those sections of stream in which planted fish live, grow, and add to the angler's bag.

10560. Clark, John R. (Bur. of Sport Fisheries and Wildlife, Sandy Hook Marine Lab., Highlands, N.J.). 1969. THERMAL POLLUTION AND AQUATIC LIFE. Scientific American, 220(3): 18-27.

Lakes, rivers, and estuaries of the United States are in danger of pollution from the heated effluent of power plant steam condensers. This threat stems from predictions of a ninefold increase in demand for electricity in the United States in the next few decades. Much of the increase will be from nuclear-powered plants which create 60% more waste heat than coal-fired plants. A 1,000-megawatt plant discharges a half million gallons a minute at a temperature elevation of 20° F. Because temperature is a primary factor controlling all life in lakes, rivers and estuaries, any major change in the seasonal thermal regime will affect whole systems of aquatic life. The greatest threat is expected to be from sub-lethal effects with only occasional outright and obvious kills of fish or other forms. Methods to combat possible adverse effects of thermal pollution include cooling towers and lakes and the use of special strategies of effluent release that would minimize expected damages. Any of these methods would add slightly to the cost of electricity to the consumer. No practicable method has yet been discovered for commercial use of the waste heat that will be produced by power plants of the future. (Auth.)

10561. Oliver, G.C.S. 1968. THE DEVELOPMENT OF A TROUT FISHERY IN A LOWLAND RESERVOIR (EYE BROOK). J. Instn Wat. Engrs., Vol. 22, pp. 129-136.

10562. Breder, C.M., Jr. 1967. ON THE SURVIVAL VALUE OF FISH SCHOOLS. *Zoologica*, 52(2): 25-40.

The range of sight, limited as it is by transparency of the water and the amount of light present, governs the effectiveness of schooling as a form of predation control, which varies widely with environmental features. The geometry of the school shape and its motion affects the conspicuousness of schools where water transparency permits good visibility. In situations where visibility is not a limiting factor, the system presents the degenerate limit where schooling fails to protect effectively. The general quietness of fish schools, except under special conditions where some sound may be inevitable or others in which it may be desirable, suggests that there may have been suppression of sound in schooling fishes, probably by way of selection. The physical form and attitudes of the constituent fishes bear on the effectiveness of schools as a protective device, as do the shape and motion of them, schooling being associated chiefly with streamlined fishes, less often with chunky or odd-shaped fishes. Sufficiently large schools may act as a repellent to predators because of their size and shape. School size is related to the availability of fishes of sufficient similarity of size to compose a coherent group, as well as the mechanics of flow within the group, and to this extent becomes amenable to treatment by hydrodynamic means. The size of the predators relative to the size of the prey leads to "stalking" if the sizes are about equal and to planktonic sifting if the prey is extremely small compared with the predator. The whole matter of schooling and aggregating is looked upon as a mechanism of behavioral homeostasis and as such is subject to the influences of selective processes. (Auth. summ.)

10563. Bureau of Sport Fisheries and Wildlife. 1968. NATIONAL SURVEY OF NEEDS FOR HATCHERY FISH. Bureau of Sport Fisheries and Wildlife Resource Publ. 63. 71 p.

Inland waters. In 1965, there were 81.6 million acres of inland sport fishing waters and this amount will increase to 91.7 million acres by the year 2000. About two-thirds of the waters support cold-water fishes. Almost 60% of the cold waters are and may continue to be stocked. About 13.3 % of the waters classified as cold waters, or those capable of supporting salmonids, also support warm-water fisheries. At present, about one-third of the 27.4 million acres of warm waters and 7.0 million acres of combination waters supporting both warm- and cold-water fisheries require periodic stocking. By the year 2000, about 38% of these waters will require periodic stocking. Three-fourths of the 29 million anglers reported for 1965 were warm-water fishermen. It is anticipated that this ratio of three warm-water to one cold-water fisherman will remain fairly constant in the future. According to State estimates, the average fisherman fishes about 13 days per year and will continue to fish at this rate. Trout and salmon fishermen average from 9 to 10 days per year while warm-water anglers average from 14 to 15 days. The requirements for hatchery fish, unless proper steps are taken, will continue to be much greater than the supply. The total number of trout produced in 1965 exceeded the requirements by 4.2 million, but in weight there was a deficit of about 1 million pounds. Under present plans, trout production will increase more rapidly than requirements until 1973, when needs will exceed production by 463,000 pounds; but by 1980 the requirements will exceed production by 1.2 million pounds. By the year 2000, the deficit may reach 7 million pounds. Salmon production in 1965 was less than the requirements by almost 3 million fry, 162,000 fingerlings, and 1.1 million yearlings. By 1973, salmon requirements may exceed production by 10.6 million fish, and by 1980 the deficit may reach 21.2 million. The requirements for warm-water hatchery fish exceeded the supply in 1965 by 683 million fish, including 559 million fry, 122 million fingerlings, and almost 2 million catchables. By 1973, under present plans, the deficit in warm-water hatchery fish will be reduced to 333 million fish and will remain at slightly over 315 million through the century.

Marine waters. Marine waters of the United States, extending 3 miles out from the coasts, cover about 70 million acres. There were 13 million salt-water fishermen in 1965, and it is anticipated that this number will increase to 29 million by the

year 2000. The average salt-water angler fished about 8 days during 1965, and it is anticipated that he will fish about 9 days during the year 2000. Except for anadromous fishes which were stocked in fresh water and which venture to sea, no fish were stocked in the sea in 1965. Consideration is being given to stocking marine species in the future.

10564. Mason, Jack. 1968. DAMS ON TROUT STREAMS? Wisconsin Conservation Bull., 33(4): 22-23.

Studies have begun on the effects of two dams on Wisconsin trout streams. Preimpoundment studies now will show existing conditions while postimpoundment studies later will show the effects on volume of streamflow, water quality, and bank cover. One reservoir will be about 43 acres on Nederlo Creek and the other about 220 acres on Cave Hollow Creek. Both will have their outlets at the bottom of the dam.

10565. Johansen, Kjell, and David Hanson (Dept. of Zoology and Friday Harbor Laboratories, Univ. of Washington, Seattle, Wash.). 1967. HEPATIC VEIN SPHINCTERS IN ELASMOBRANCHS AND THEIR SIGNIFICANCE IN CONTROLLING HEPATIC BLOOD FLOW. J. Exp. Biol., 46(2): 195-203.

Discrete muscular sphincters have been discovered on the hepatic veins of elasmobranch fishes. Their anatomy has been studied by gross dissection and by histological techniques. Their functional significance has been assessed by application of drugs to excised sphincters and by measurements of intravascular pressures in free-swimming fishes by means of chronically indwelling catheters. Topical application of acetylcholine caused contraction of the sphincters and adrenaline facilitated relaxation. Pressure measurements disclosed that the hepatic venous pressures in general exceed those in the central systemic veins, thus indicating partial or complete closure of the hepatic vein sphincters. The hepatic vein pressures showed spontaneous phasic changes reflecting closure and opening of the sphincters. It is suggested that hepatic vein sphincters are of particular significance in elasmobranchs since negative pressures prevail in the sinus venosus and central venous sinuses, exerting suctional attraction for venous blood. A sphincteric release of hepatic blood provides a structural basis for delicate adjustments of the volume and transit time of blood in the liver and for mobilization of blood stored in the liver at times of increased demand on cardiac output. The findings are discussed in relation to general mechanics of venous return in fishes and are compared with studies of hepatic vascular sphincters in other vertebrates. (Authors summ.)

10566. Potts, W. T. W., M. A. Foster, P. P. Rudy, and G. Parry Howells. 1967. SODIUM AND WATER BALANCE IN THE CICHLID TELEOST, Tilapia mossambica. J. Exp. Biol., 47(3): 461-470.

The total body sodium increases from 45.9 $\mu\text{M/g}$ fish in fresh water to 59.9 $\mu\text{M/g}$ fish in 200% sea water. The rate of exchange of sodium increases from 2 $\mu\text{M/g/hr}$ in fresh water to 60 $\mu\text{M/g/hr}$ in 100% sea water. The rate of drinking increases from 0.26%/hr fresh water to 1.6%/hr in 400% sea water. Even in 200% sea water drinking accounts for only a quarter of the total sodium influx. The permeability to water, as measured by tritiated water, is highest in fresh water and lowest in 200% sea water. The permeabilities to water measured in this way are consistent with the drinking rates determined in sea water and 200% sea water. (Authors summ.)

10567. Evans, David H. (Dept. of Biological Sciences, Stanford Univ., Stanford, Calif.). 1967. SODIUM, CHLORIDE AND WATER BALANCE OF THE INTERTIDAL TELEOST, Xiphister atropurpureus. I. REGULATION OF PLASMA CONCENTRATION AND BODY WATER CONTENT. J. Exp. Biol., 47(3): 513-517.

Studies were undertaken to determine the degree of regulation of sodium, chloride and water displayed by the intertidal teleost, Xiphister atropurpureus, over a range of salinities. The plasma concentrations of sodium and chloride declined by approximately 15% in 10% sea water (48 mM-Na/kg) and the intracellular spaces increased by approximately 6% in 10% sea water. (Auth. summ.)

10568. Evans, David H. (Dept. of Biological Sciences, Stanford Univ., Stanford, Calif.). 1967. SODIUM, CHLORIDE AND WATER BALANCE OF THE INTER-TIDAL TELEOST, Xiphister atropurpureus. II. THE ROLE OF THE KIDNEY AND THE GUT. J. Exp. Biol., 47(3): 519-534.

The rate of loss of sodium, chloride and water via the urine and the rate of intake of sodium, chloride and water by ingestion of the medium was determined for the euryhaline teleost, Xiphister atropurpureus. The urinary losses of sodium and chloride were approximately 0.5 mM/kg fish/day in both 100% sea water (480 mM-Na/kg) and 10% sea water. The ingestion of sodium and chloride by drinking the medium amounted to approximately 4 mM/kg fish/day in 100% sea water and approximately 0.1 mM/kg fish/day in 10% sea water. The low rate of urine flow in 10% sea water and the low drinking rate in 100% sea water indicate a relative impermeability to water in both salinities. (Auth. summ.)

10569. Evans, David H. (Dept. of Biological Sciences, Stanford Univ., Stanford, Calif.). 1967. SODIUM, CHLORIDE AND WATER BALANCE OF THE INTER-TIDAL TELEOST, Xiphister atropurpureus. III. THE ROLES OF SIMPLE DIFFUSION, EXCHANGE DIFFUSION, OSMOSIS AND ACTIVE TRANSPORT. J. Exp. Biol., 47(3): 525-534.

The effluxes of ^{22}Na , ^{36}Cl and tritiated water from the euryhaline teleost, Xiphister atropurpureus were determined in 100% sea water (480 mM-Na/kg) and 10% sea water. Only the flux of sodium in 100% sea water contained an exchange diffusion component. The relative impermeability of Xiphister is shown by its low fluxes of sodium, chloride and water in both salinities. In 10% sea water the permeability to sodium declined while the permeability to chloride and water remained at sea water levels. In both salinities diffusion and active transport are the major components of the sodium and chloride balance of Xiphister. (Auth. summ.)

10570. Parsons, John David. 1968. THE EFFECTS OF ACID STRIP-MINE EFFLUENTS ON THE ECOLOGY OF A STREAM. Arch. Hydrobiol., 65(1): 25-50.

The complete oxidation of iron sulfide occurs on spill piles. Strip-mine lakes act as holding areas of oxidized sulfuritic material. Cedar Creek, in Missouri, was affected by both continuous and periodic flows of acid-mine effluents. The longitudinal succession associated with a stream of this type has been modified in biotic response to the continuous atypical aquatic environment as a function of effluent ions. The greatest deviation from the expected pattern was found in fishes, and the least in the benthos with its great dependency upon the abiotic substrate, and of intermediate response the zooplankters with both inhabitable volume as well as water quality being a factor. In both zooplankton and benthic populations in the continuously polluted area, the number of species was small compared to the total number of individuals. This was in direct contrast to the biotic structure in the downstream area. The populations of fishes in the periodically polluted area were typical of streams in the surrounding area. In the final analysis, not only the initiation of an excess acid flow, the maintenance of such a flow, the concentration of effluent ions, and the distance travelled by such a flow, but also the rate of recovery of the downstream area were dependent upon a delicate, ever-changing balance in the amount, distribution, and intensity of rainfall, and to some extent, upon the time interval between rains. The effects of acid effluents upon the abiotic environment were the a) precipitation of the normal silt load, b) destruction of the bicarbonate buffer system, c) increase in the titratable acidity and hydrogen-ion concentration, d) introduction of various metal ions, and e) reduction of the oxygen concentration in the downstream stations. The acidity of the strip-mine effluent as measured by titratable acidity and hydrogen-ion concentrations was responsible for the destruction of animal populations of the downstream communities. The response of the community structure to the abiotic environment during the a) normal, b) pollution, and c) recovery conditions was studied comparatively. A complete picture of the biotic response to abiotic environment has been ascertained based on community response. The repopulation of the ecosystem was dependent upon a) water quality, b) type of life cycle, and c) season of high water. (Auth. summ.)

10571. Sprague, John B. (Fish. Res. Bd. of Canada, Biological Station, St. Andrews, N.B., Canada). 1968. AVOIDANCE REACTIONS OF RAINBOW TROUT TO ZINC SULPHATE SOLUTIONS. *Water Research*, 2(5): 367-372.

Rainbow trout (*Salmo gairdnerii* Richardson) showed strong avoidance reactions to sublethal concentrations of zinc sulphate. The threshold avoidance level was 5.6 µg/l of zinc added to laboratory water. This is only 0.01 of the lethal threshold concentration. There were no significant differences in threshold avoidance levels at 9.5° and 17° C, nor when background of zinc in the water was increased during acclimation and/or testing, from 3 µg/l to 13 µg/l. (Auth.)

10572. Lyman, Lee D., William A. Tompkins, and James A. McCann. 1968. RESIDUES IN FISH, WILDLIFE, AND ESTUARIES. *Pesticides Monitoring Jour.*, 2(3): 109-122.

Fish, representing a number of indigenous fresh-water species, were collected in all of the major watersheds in Massachusetts during the summers of 1965, 1966, and 1967. Individual analyses of these fish were conducted to determine the concentrations of DDT and its metabolites, DDE and DDD (TDE). A total of 1,310 individual fish specimens were collected and analyzed from 93 stations. Mean DDT concentrations, based on the analysis of a minimum of five fish per station, ranged from 0.17 to 28.88 ppm. Residues of DDT in individual fish specimens ranged from 0.00 to 49.10 ppm. Comparison of the mean concentrations of DDT between different fish species showed that some species had varying abilities to concentrate DDT. Neither length nor weight was related to the concentration of pesticide found in yellow perch and pumpkinseed. Some samples portrayed extreme variation in the concentration of pesticide found in individual fish. These variations could not be explained. Generally, there was an increase in pesticide concentration in fish from the various watersheds of the State during the 3-year study period. All data are expressed in parts per million of pesticide found in whole fish, based on dry weight. Conversion factors to change parts per million based on dry weight to parts per million wet weight were determined for nine species of fish. (Authors)

10573. Burdick, G.E., H.J. Dean, E.J. Harris, Jack Skea, Charles Frisa, and Clare Sweeney. 1968. METHOXYCHLOR AS A BLACKFLY LARVICIDE, PERSISTENCE OF ITS RESIDUES IN FISH AND ITS EFFECT ON STREAM ARTHROPODS. *N. Y. Fish Game J.*, 15(2): 121-142.

Low-level exposures of brook trout indicated that accumulation of methoxychlor was generally less than that of DDT. Based on the average accumulation in three brook trout after exposure to methoxychlor, loss of 41.3% of the accumulation occurred within 1 week after the fish were transferred to clean spring water. No residue was detected after 3 months. Hatchery ponds, stocked ecological system, were used to compare the accumulation and elimination of DDT and methoxychlor in the fish and some members of the food chain. Three separate additions of chemical were made at intervals in 1965 to produce calculated concentrations of +0.005 ppm of DDT in one pond and of methoxychlor in the other. Two similar applications were made in 1966. Samples were taken 36 and 118 days after the final addition in 1965 and 63 days after the final addition in 1966. No methoxychlor was detectable in any sample in either year. DDT and its metabolites were present in all samples from the DDT-treated pond. Residues in the fish ranged from 1.68 to 9.4 ppm in terms of wet weight in 1965. Residues increased in young-of-the-year sunfish between 36 and 118 days after the final application. Crayfish, snails and dragonfly larvae also contained residues. In 1966 fish from both ponds showed a reduction in fat and oil expressed as percentage of body weight. Those from the DDT pond approached a level indicative of acute starvation, which could be attributed to the effect of the chemical on food organisms. DDT residues were also lower than in 1965. A laboratory study of the effect of starvation on fats, oils and stored DDT residues was conducted on brown trout. Proportionate reduction of p-pDDT occurred coincident with the metabolism of fats and oils bearing that chemical. However, DDT residues, including DDE, were not reduced proportionately. Methoxychlor as a blackfly larvicide seems unlikely to produce residues of the magnitude and persistence known to occur when DDT is used. Preliminary studies of methoxy-

chlor preparations applied as blackfly larvicides were made, based on stream bottom sampling. Oil solutions and emulsifiable concentrates were found more effective as larvicides than wettable powder, but they also had greater effect on other arthropods. A 15% solution applied at 1 gallon per flight mile appeared as effective as a 20% solution of DDT at a similar application rate. Based on previously obtained, unpublished data on DDT, the effect of methoxychlor on other stream arthropods appeared to be no greater than that of DDT as formerly used. (Authors)

10574. Forney, John L. 1968. PRODUCTION OF YOUNG NORTHERN PIKE IN A REGULATED MARSH. N. Y. Fish Game J., 15(2): 143-154.

From 1964 to 1967 the production and survival of young northern pike were studied in an experimental marsh at Shackelton Point on Oneida Lake. The number of adults entering the marsh was controlled and their fecundity estimated to determine potential egg deposition. The number of eggs hatching was approximated by determining the density of fry per square foot using screen inclosures, and young emigrating from the marsh were trapped and enumerated. Mortality between spawning and hatching was 81 and 84% in 1965 and 1966, respectively, and the loss of young between hatching and emigration was 83% in both years. Migrants over 65 mm long were fin clipped. Recoveries during subsequent spawning runs suggested that few pike survived that were less than 65 mm long when they left the marsh. Maintenance of northern pike populations in many lakes may depend primarily on producing large juvenile fish in the nursery areas. (Auth.)

10575. Briggs, Philip T. 1968. THE SPORT FISHERIES FOR SCUP IN THE INSHORE WATERS OF EASTERN LONG ISLAND. N. Y. Fish Game J., 15(2): 165-185.

The sport fisheries for scup in the inshore waters of eastern Long Island were studied between May 1 and November 30 from 1964 through 1966. Anglers using rowboats (based primarily in the Peconic Bays) and open boats (based primarily at Montauk Harbor) were heavily dependent upon scup. Together, these facilities accounted for two-thirds, or more, of all scup anglers and over two-thirds of all scup caught. The rowboat anglers had their highest catches and catches per effort in May. The open boat anglers had their greatest success from midsummer to early fall. Differences between these and other sport fisheries for scup, as well as seasonal fluctuations in scup abundance, are discussed. For rowboat anglers in the Peconic Bays the largest fish were caught in May, and after that the size declined. There was also an indication of a missing year class that apparently caused declines in the sport fisheries in the summer of 1966. The possible effect of this missing year class upon the commercial landings of scup is noted. (Auth.)

10576. Hall, Donald J., and George G. Waterman. 1968. ZOOPLANKTON OF THE ADIRONDACKS. N. Y. Fish Game J., 15(2): 186-190.

Describes the occurrence of crustacean zooplankton species in 36 lakes and ponds representative of the major drainage basins in the Adirondack region.

10577. Wilson, R. P., R. O. Anderson, and R. A. Bloomfield (Depts. of Agricultural Chemistry and Zoology, Univ. of Missouri, Columbia, Mo.). 1969. AMMONIA TOXICITY IN SELECTED FISHES. Comp. Biochem. Physiol., 28(1): 107-118.

Intraperitoneal LD₅₀ and LD_{99.9} values for ammonium acetate were determined in three species of ammonotelic fishes; rainbow trout (*Salmo gairdnerii*), channel catfish (*Ictalurus punctatus*) and goldfish (*Carassius auratus*). There was a direct relationship between the LD₅₀ values for ammonium acetate and the relative resistance to environmental conditions, i.e. the trout were the most sensitive, the channel catfish intermediate and the goldfish quite resistant. An increase in aquarium temperature considerably decreased the fishes tolerance to the injected ammonium acetate. Fishes being ammonotelic were found to be more tolerant to the intraperitoneally administered ammonium acetate than either the ureotelic or uricotelic species. Several factors which may contribute to the higher tolerance of exogenous ammonia in the fishes are discussed. (Authors)

10578. Carey, Francis G., and John M. Teal (Biology Dept. Woods Hole Oceanographic Institution, Woods Hole, Mass.). 1969. REGULATION OF BODY TEMPERATURE BY THE BLUEFIN TUNA. *Comp. Biochem. Physiol.*, 28(1): 205-213.

Bluefin tuna (*Thunnus thynnus* Linnaeus) can control the temperature of their bodies (25-30° C) so that the warmest portion of the muscle mass varies only 5° C over a 10° - 30° C range of water temperature. (Authors)

10579. Hebb, Catherine, D. Morris, and M. W. Smith. 1969. CHOLINE ACETYLTRANSFERASE ACTIVITY IN THE BRAIN OF GOLDFISH ACCLIMATED TO DIFFERENT TEMPERATURES. *Comp. Biochem. Physiol.*, 28(1): 29-36.

The effect of temperature acclimation on acetylcholine (ACh) synthesis by goldfish brain homogenates prepared from fish acclimated to 8, 15, 25 and 32° C has been investigated. The enzyme responsible for ACh synthesis, choline acetyltransferase, is stable at incubation temperatures higher than previous acclimation temperatures. The activity of the enzyme is greater at higher acclimation temperatures. There was no evident difference in the kinetic properties of the enzyme measured at high incubation temperatures, 39-45° C. At lower incubation temperatures, 15-25° C, the kinetic constants did vary suggesting possible differences in enzyme properties. (Authors)

10580. Grove, D. J. 1969. THE EFFECTS OF ADRENERGIC DRUGS ON MELANOPHORES OF THE MINNOW, *Phoxinus phoxinus* (L.). *Comp. Biochem. Physiol.*, 28(1): 37-54.

The chromatic activity and potency of some adrenergic drugs (sympathomimetic amines, α - and β -adrenergic blocking agents and hypotensive agents) were investigated in intact and operated minnows using the Derived Ostwald Index as a simple method for measuring melanophore responses. The actions of the drugs, and the changes in sensitivity of sympathomimetic amines after operations, suggest that chromatic fibres entering the autonomic chain of the fish are preganglionic and possibly cholinergic. Postganglionic fibres from sympathetic ganglia are adrenergic, pass straight to the skin in the mixed spinal nerves and innervate the melanophores directly. The fibres release catecholamine transmitter from an adrenergic store in or near the axon terminals which stimulates pigment aggregation by combination with an adrenergic receptor which has α -properties. (Auth.)

10581. Grove, D. J. 1969. MELANOPHORE DISPERSION IN THE MINNOW *Phoxinus phoxinus* (L.). *Comp. Biochem. Physiol.*, 28(1): 55-65.

The intense darkening following lesions in the chromatic tract of pale minnows appears to be active and lasts approximately 24 hours. This darkening is antagonized by sympathetic blockade and the paling actions of catecholamines are reduced. Although the darkening of minnows may be nervously controlled, there is no pharmacological evidence for cholinergic "parasympathetic" darkening fibres in the minnow. In the absence of active paling and darkening fibres, the unsupported action of paling hormone cannot bring about full pallor of white-adapted minnows. (Auth.)

10582. Kirby, S., and G. Burnstock. 1969. COMPARATIVE PHARMACOLOGICAL STUDIES OF ISOLATED SPIRAL STRIPS OF LARGE ARTERIES FROM LOWER VERTEBRATES. *Comp. Biochem. Physiol.*, 28(1): 307-319.

The effect of drugs and transmural electrical stimulation on spiral strips of the systemic artery of the lizard and toad and the ventral aorta of the trout and eel have been studied. Adrenergic nerve plexuses in the artery wall have been demonstrated with the fluorescent histochemical method. Transmural stimulation produced contraction which was mimicked by acetylcholine and noradrenaline and partially blocked by atropine and by both α - and β -adrenergic blocking agents. Evidence is presented which suggests that there is a progressive increase in adrenergic compared to cholinergic nervous excitatory control of large arteries during evolution from fish to mammals. (Authors)

10583. Ezell, George H., L. L. Sulya, and C. L. Dodgen. 1969. THE OSMOTIC FRAGILITY OF SOME FISH ERYTHROCYTES IN HYPOTONIC SALINE. *Comp. Biochem. Physiol.*, 28(1): 409-415.

Osmotic fragility curves of erythrocytes from eleven species of marine teleosts from the Gulf of Mexico are of the normal sigmoid type. The mean corpuscular fragility value is generally consistent within a species but varies widely among the different species. Two species of gars, Lepidosteus osseus and L. productus, have erythrocytes which are resistant to hemolysis in hypotonic sodium chloride solutions. (Authors)

10584. Koo, S. Y., and Andhi Isarankura (Fishery Research Inst., College of Fisheries, Univ. of Washington, Seattle, Wash.). 1968. OBJECTIVE STUDIES OF SCALES OF COLUMBIA RIVER CHINOOK SALMON, Oncorhynchus tshawytscha (Walbaum). U.S. Fish and Wildlife Service Fishery Bulletin, 66(2): 165-180.

This study uses an objective method that measures and graphs the spacings of circuli. It also introduces a new method of differentiating ocean nucleus from stream nucleus. Four groups of chinook salmon scales were studied, each with a specific purpose. First, scales from recoveries of two kinds of marked fall chinook at Spring Creek National Fish Hatchery were compared: one kind was from fish released as fry, and the other from fish released as fingerlings. In the nuclear part of scale growth, the group released as fry showed a larger variance in spacing of circuli than the group released as fingerlings but the difference in the mean values between these two groups was not significant. In the first marine part of scale growth, circulus spacing was significantly wider in the group released as fry than in the group released as fingerlings. It was not possible, however, to identify individual scales as coming from fish released as fry or as fingerlings. Second, scales from marked and unmarked fall chinook salmon at Spring Creek Hatchery were compared to see if any effect of marking could be detected. Significant differences in circulus spacing in marine growth existed between marked and unmarked fish, the latter having wider spacings. Marking was in the removal of adipose and right pectoral fins from chinook fingerlings. This technique was therefore regarded as having unfavorably affected the growth of marked fish. Third, scales from marked fall chinook that had been released at various times of the year at Little White Salmon National Fish Hatchery were studied. The scales showed that young chinook salmon released in May and July of the first year grew an ocean nucleus typical of fall chinook; those released in February of the second year grew a stream nucleus typical of spring chinook; and those released in September and October of the first year grew a nucleus intermediate in character. Fourth, scales of fall and spring chinook salmon were studied to see how these two groups could be identified by their scales. Measurements of circulus spacing in the first and second summer of marine growth revealed that, in the spring chinook, marine circuli in both summers were about equally wide; whereas, in the fall chinook, marine circuli of the second summer were nearly one and one-half times wider than those of the first summer. Thus, these scales can be distinguished, not by nuclear growth as is normally done by subjective judgment, but by relative marine growth as measured by objective means. (Authors)

10585. Hutton, Kenneth E. (Dept. of Biological Sciences, San Jose State College, San Jose, Calif.). 1968. CHARACTERISTICS OF THE BLOOD OF ADULT PINK SALMON AT THREE STAGES OF MATURITY. U.S. Fish and Wildlife Service Fishery Bulletin, 66(2): 195-202.

Selected characteristics of the blood of adult pink salmon (Oncorhynchus gorbuscha) were studied in fish at three stages of maturity—migrating fish approaching the general area of spawning streams but still in the open ocean, fish in the immediate vicinity of the spawning stream but in the estuary, and fish in the spawning stream. Although some hematological characteristics changed little, blood proteins, glucose, and cholesterol decreased progressively, and lipid phosphorus increased. (Auth.)

10586. Rivas, Luis R., and Stanley M. Warlen (Bur. of Commercial Fisheries Exploratory Fishing Base, Pascagoula, Miss.). 1968. SYSTEMATICS AND BIOLOGY OF THE BONEFISH, Albula nemoptera (Fowler). U.S. Fish and Wildlife Service Fishery Bulletin, 66(2): 251-258.

This study is a review of the taxonomic status of the bonefish, Albula nemoptera, formerly placed in the genus Dixonina. Reasons for synonymizing Dixonina with Albula are discussed, and it is shown that pacifica is conspecific with nemoptera. The Atlantic and Pacific populations of nemoptera are compared with each other and with the common bonefish, A. vulpes. Presumed larval and juvenile stages of nemoptera are described and compared with those of vulpes. The ecology and distribution of nemoptera and vulpes is discussed. (Authors)

10587. Royce, William F., Lynwood S. Smith, and Allan C. Hartt (Fisheries Research Inst., College of Fisheries, Univ. of Washington, Seattle, Wash.). 1968. MODELS OF OCEANIC MIGRATIONS OF PACIFIC SALMON AND COMMENTS ON GUIDANCE MECHANISMS. U.S. Fish and Wildlife Service Fishery Bulletin, 66(3): 441-462.

The general oceanic distribution and migratory behavior of Pacific salmon are summarized, and a model of the entire migration is developed for each of three typical stocks. The pink salmon of southeastern Alaska and British Columbia circle the Gulf of Alaska counterclockwise within an area generally bounded on the west by long. 155° W. and on the south by lat. 41° N. They travel generally "downstream" in the Alaskan Gyre and the associated currents. The pink salmon of the Karaginski district on East Kamchatka also apparently make a counterclockwise circuit of the Bering Sea and North Pacific Ocean in an area bounded approximately on the west by long. 155° E., on the south by lat. 40° N., on the east by long. 150° W., and on the north by lat. 60° N. Their migratory circuit is generally "downstream": southward in the East Kamchatka Current, eastward in the Subarctic Current, and finally westward and northward in the Alaskan Stream and the Bering Sea Gyre. The sockeye salmon of Bristol Bay make two or three counterclockwise circuits in the Bering Sea and North Pacific Ocean within an area bounded approximately on the north by lat. 60° N., on the west by long. 165° E., on the south by lat. 45° N., and on the east by long. 140° W. The number of circuits depends upon the number of winters spent by the salmon at sea. In general, they travel "downstream" in the major current systems within the area defined. The time schedule, rate of travel, and average size of the fish at various stages are described for each of the three stocks. On the basis of this summary, we believe that the salmon's migrations could not be performed if they migrated or drifted at random, or if they depended on memorized visual or olfactory cues except for final location of the home estuary and stream. The salmon predominantly travel actively with the residual ocean currents in circular migration routes. Many races could accomplish their migrations by moving down or across currents until close to the mouths of their home streams, where they might recall memorized olfactory cues. Also, ocean currents produce electric potentials in a range that some fish can detect; therefore, salmon might depend for navigation on electromagnetic cues from ocean currents. Furthermore, their responses to all migratory cues must be inherited, not memorized. (Authors)

10588. Vaux, Walter G. (Bur. of Commercial Fisheries Biological Lab., Auke Bay, Alaska). 1968. INTRAGRAVEL FLOW AND INTERCHANGE OF WATER IN A STREAMBED. U.S. Fish and Wildlife Service Fishery Bulletin, 66(3): 479-489.

The chemical quality of intragravel water in streams—the environment of salmon eggs, embryos, and alevins—is influenced by the rate of interchange of stream water and intragravel water. Factors controlling the direction and magnitude of flow or interchange of this water were identified in this study. Equations describing motion of waterflow within the streambed under specified boundary conditions are developed, and tests of the mathematical model with an electrolytic bath analog model are described. The direction of waterflow within a streambed and the interchange of water between the bed and the stream depend primarily on the permeability, depth and longitudinal profile of the porous streambed. Water

upwells where permeability or depth of gravel decreases in the direction of stream-flow and where the longitudinal bed profile is concave. Water downwells where permeability or depth of gravel increases in the direction of streamflow or where the longitudinal bed profile is convex. (Auth.)

10589. McNeil, William J. (Pacific Fisheries Lab., Oregon State Univ., Marine Science Center, Newport, Oreg.). 1968. MIGRATION AND DISTRIBUTION OF PINK SALMON SPAWNERS IN SASHIN CREEK IN 1965, AND SURVIVAL OF THEIR PROGENY. U.S. Fish and Wildlife Service Fishery Bulletin, 66(3): 575-586.

The escapement of 14,813 pink salmon (*Oncorhynchus gorbuscha*) to Sashin Creek, southeastern Alaska, in 1965, followed by the emergence of 2.2 million fry, or 18% of the potential egg deposition, represented a relatively high survival of eggs and alevins in a stream, where the long-term average is 7%. This high survival was predicted from an established relation between survival of eggs and alevins and the time the parents entered Sashin Creek to spawn. The spawning ground was divided into three areas—upper, middle, and lower—to study density of spawners and survival of their progeny. Density in 1965 was higher in the middle and upper areas than in the lower. From egg deposition to fry emergence, survival was estimated to be 23% in the upper area, 18% in the middle area, and 14% in the lower area. The instantaneous rate of mortality remained relatively unchanged from deposition of eggs to emergence of fry in the upper and middle areas. In the lower area, mortality was relatively high during spawning and low between spawning and hatching of eggs. Much of the mortality throughout the stream was traced to the disappearance of eggs and alevins. Factors causing this disappearance included retention of eggs, superimposition of redds, predation, and turbulent water. A drought during spawning retarded development of embryos and caused considerable mortality. (Auth.)

10590. Long, Clifford W. (Bureau of Commercial Fisheries Fish-Passage Research Program, Seattle, Wash.). 1968. DIEL MOVEMENT AND VERTICAL DISTRIBUTION OF JUVENILE ANADROMOUS FISH IN TURBINE INTAKES. U.S. Fish and Wildlife Service Fishery Bulletin, 66(3): 599-609.

The behavior of fingerling salmonids was measured in turbine intakes of the Dalles and McNary Dams on the Columbia River to aid in developing methods for reducing fish mortality in Kaplan turbines. At the Dalles Dam, diel movement and vertical distribution were sampled at both ends and at the middle of the section of the powerhouse that housed turbines 1 through 12. At McNary Dam, vertical distribution was sampled in intake 12-C, located near the middle of the river channel. Comparisons of day-night occurrence at the Dalles Dam showed that most chinook salmon (*Oncorhynchus tshawytscha*), steelhead trout (*Salmo gairdneri*), and ammocoetes of the Pacific lamprey (*Lampetra tridentata*) were caught at night (7 p.m. to 7 a.m.). Vertical distribution studies at McNary and Dalles Dams included catches of sockeye salmon (*O. nerka*) in addition to the above species. Salmonids were taken at all depths, but most were in the upper 30% of water in the intakes (within 4.6 m of the ceiling). Ammocoetes at the Dalles Dam (no data for McNary Dam) were concentrated near the center and bottom of the intakes; very few were near the ceiling. To increase survival of fish by manipulating turbine loads during a 24-hour operational period appears feasible. During darkness when fish movements through turbines increase and power demands decrease, the reduction in turbine loads improves the flexibility for adjusting turbine loads to increase fish survival. The concentration of fingerling salmonids near intake ceilings probably causes most of the fish to pass the turbine runner at or near the hub; therefore, methods for eliminating lethal factors at the runner should be applied first at the hub. In addition, use of deflection and bypass techniques near intake ceilings would be advantageous because the concentration of fish is greatest there. (Auth.)

10591. Oren, O.H. (Sea Fisheries Research Station, Haifa, Israel). 1968. ARTIFICIAL REEFS. A SHORT REVIEW AND APPEAL. FAO Fisheries Circular No. FRs/C305. 8 p.

10592. Stout, Virginia F. (Bur. of Commercial Fisheries Technological Lab., Seattle, Wash.). 1968. PESTICIDE LEVELS IN FISH OF THE NORTHEAST PACIFIC. Bull. Environ. Contam. Toxicol., 3(4): 240-246.

A program was initiated to monitor the pesticide levels of edible fish in the Pacific Northwest. The residues monitored were DDT and its metabolites, DDE and TDE. The species sampled were anchovy (Engraulis mordax), Dungeness crab (Cancer magister), English sole (Parophrys vetulus), hake (Merluccius productus), ocean perch (Sebastes alutus), starry flounder (Platichthys stellatus), true cod (Gadus macrocephalus), and yellowtail rockfish (Sebastes flavidus). Results are tabulated.

10593. Ragab, Mohamed Tawfik H. (Dept. of Agricul. Chemistry and Bur. of Conservation and Environmental Science, Rutgers Univ., New Brunswick, N. J.). 1968. GAS CHROMATOGRAPHIC ANALYSIS OF MALATHION IN WATER AND IN FISH. Bull. Environ. Contam. Toxicol., 3(3): 155-163.

The successful use of malathion in the field of pest control and its possible translocation in the environment has necessitated the development of a simple and sensitive method for its determination in water and in fish. The present paper describes a reliable sequence of techniques for such determinations.

10594. Cairns, John, Jr. 1968. THE EFFECTS OF DIELDRIN ON DIATOMS. Mosquito News, 28(2): 177-179.

At a dieldrin concentration of 12.8 ppm the number of diatoms was only half that in the controls at the end of the 5-day growth period. There was no increase in the number of cells at 32.0 ppm, and a concentration of 1.8 ppm was only 10.6 percent different from the controls.

10595. Bishop, John W. (Div. of Biological Sciences, Cornell Univ., Ithaca, N.Y.). 1968. RESPIRATORY RATES OF MIGRATING ZOOPLANKTON IN THE NATURAL HABITAT. Limnol. & Oceanogr., 13(1): 58-62.

Rates of oxygen consumption by zooplankton in Cayuga Lake were measured when the lake was stratified. The effects of temperature, pressure, and light were examined. Animals from the epilimnion, mostly cladocerans, and from the hypolimnion, mostly copepods, respired at similar rates in their respective habitats. When the animals were placed in the same habitats, copepods from the hypolimnion had the greater rates of respiration. Copepods, which migrated over an extensive vertical distance daily, were less sensitive to changes in depth than were cladocerans, which remained within a narrow vertical range. The copepods were less affected by changes in pressure and temperature within than outside their range of migration. (Auth.)

10596. Martin, John H. (Graduate School of Oceanography, Univ. of Rhode Island, Kingston, R.I.). 1968. PHYTOPLANKTON-ZOOPLANKTON RELATIONSHIPS IN NARRAGANSETT BAY. III. SEASONAL CHANGES IN ZOOPLANKTON EXCRETION RATES IN RELATION TO PHYTOPLANKTON ABUNDANCE. Limnol. & Oceanogr., 13(1): 63-71.

Phytoplankton and zooplankton were sampled at three stations in Narragansett Bay over a nine-month period at weekly or biweekly intervals. The freshly-caught plankton was then utilized in laboratory experiments in which zooplankton oxygen consumption and phosphorus and nitrogen excretion were measured. Nitrogen excretion was minimal when phytoplankton was abundant and vice versa; this phenomenon may be due to the animals' greater utilization of protein as an energy source when food is scarce. A similar relationship was observed between food abundance and phosphate excretion, and it was hypothesized that when food was abundant low rates of P excretion indicated that lipid was being stored or used in egg production or both. When food was scarce more lipid was used for energy and rates of P excretion increased. From the experimental results, it was estimated that the zooplankton provide only a small fraction of the required N and P to the phytoplankton during periods of phytoplankton abundance. However, during periods of phytoplankton scarcity, when plant nutrient requirements are low and zooplankton excretion rates are high, the zooplankton provide amounts of N and P in excess of phytoplankton demand. (Auth.)

10597. Odum, William E. (Inst. of Marine Sciences, Univ. of Miami, Miami, Fla.). 1968. THE ECOLOGICAL SIGNIFICANCE OF FINE PARTICLE SELECTION BY THE STRIPED MULLET Mugil cephalus. Limnol. & Oceanogr., 13(1): 92-98.

By tracer experiments using ^{32}P and a comparison of sediment and stomach content particle sizes, Mugil cephalus Linnaeus is shown to prefer very fine particles wherever sediments are involved in feeding. It is suggested that these small inorganic and plant detrital sediment particles are much richer both in absorbed organic material and in adsorbed bacteria, Protozoa, and other microorganisms than the coarser material that the mullet rejects. This selectivity results in substantially higher organic values of the stomach contents than of the sediments. (Auth.)

10598. Sanders, Herman O., and Oliver B. Cope (Fish-Pesticide Research Lab., Bur. of Sport Fisheries and Wildlife, Columbia, Mo.). 1968. THE RELATIVE TOXICITIES OF SEVERAL PESTICIDES TO NAIADS OF THREE SPECIES OF STONEFLIES. Limnol. & Oceanogr., 13(1): 112-117.

Static bioassays were conducted to determine the relative acute toxicities of some insecticides, herbicides, fungicides, a defoliant, and a molluscicide to the naiads of three species of stonefly, Pteronarcys californica, Pteronarcella badia, and Claassenia sabulosa. Toxic effects were measured by determination of median lethal concentration (LC_{50}) for 24-, 48-, and 96-hour exposures at 15.5°C . Endrin and dieldrin were the most and DDT the least toxic of the chlorinated hydrocarbon insecticides tested. Parathion was the most toxic organophosphate insecticide to P. californica naiads, but dursban was the most toxic to P. badia and C. sabulosa naiads. Trichlorofon (Dipterex) was the least toxic to all three species. P. badia, the species of smallest size, was the species most susceptible to most pesticides, followed in descending order of sensitivity by C. sabulosa and P. californica. Smaller specimens of P. californica naiads were consistently more susceptible to some insecticides than larger specimens of the same species. (Authors)

10599. Harder, Wilhelm (Zoophysiolgisches Institut der Universitat Tubingen, Tubingen, West Germany). 1968. REACTIONS OF PLANKTON ORGANISMS TO WATER STRATIFICATION. Limnol. & Oceanogr., 13(1): 156-168.

A survey of the literature indicates that zooplankton aggregate at salinity or temperature interfaces. The experiments reported here offer evidence that such interfaces may be preferential sites for certain marine organisms. Experiments were made by layering water of various densities and introducing planktonic organisms into the layers. The zooplankters under study included protozoa, and adults or larvae, or both, of ctenophores, chaetognaths, cirripeds, amphipods, polychaetes, brachiopods, mysids, molluscs, appendicularians, and teleost eggs. Almost all organisms tested accumulated at the interfaces of water layers. (Auth.)

10600. Black, Peter E. (State Univ. College of Forestry, Syracuse, N.Y.). 1968. STREAMFLOW INCREASES FOLLOWING FARM ABANDONMENT ON EASTERN NEW YORK WATERSHED. Water Resources Research, 4(6): 1171-1178.

Analyses of long-term precipitation, temperature, and runoff records indicate that runoff from a 180-square-mile watershed in New York State is undergoing a slow but steady change. Although potential evapotranspiration has remained constant, percentages of precipitation appearing as runoff, dormant season runoff, and total runoff have all increased as abandoned farm land passes through a brush and scrub forest stage before reverting to the mature forest. (Auth.)

10601. Brown, Charles L., and Robert Clark (Ocean Sciences Div., Navy Underwater Sound Laboratory, New London, Conn.). 1968. OBSERVATIONS ON DREDGING AND DISSOLVED OXYGEN IN A TIDAL WATERWAY. Water Resources Research, 4(6): 1381-1384.

Evidence indicates that resuspension of oxidizable bottom sediments in a tidal waterway caused significant reductions in the dissolved oxygen (DO) concentration of the water. During dredging, DO was reduced between 16-83% below normal. (Authors)

10602. Ayer, Gordon R. 1968. REFORESTATION WITH CONIFERS — ITS EFFECT ON STREAMFLOW IN CENTRAL NEW YORK. Water Resources Bull., 4(2): 13-24.

During the early 1930's, more than 340,000 acres of abandoned farmland in New York State were purchased by the State Conservation Department for the planting, growing, and harvesting of trees. Since then, this land has developed from a heavy cover of weeds and brush into dense coniferous woodlands with trees averaging well over 30 feet high. Hydrologic data have been collected since 1932 in Central New York to determine the effect of the reforestation on streamflow. Data are available for three small partly reforested areas and for one non-reforested control area. Intensive statistical analyses of the data from the four study areas were made in 1958. It was determined at that time that significant reductions in total runoff had occurred which were attributed to increases in interception and transpiration. Reductions in peak discharges during the dormant season also were indicated which were attributed to increased interception and sublimation of snowfall, and gradual desynchronization of snowmelt runoff from the wooded and open areas of partly reforested watersheds. Updating of the studies relating to peak discharges was completed in 1967 and indicated that no further changes in relative peaks had taken place since 1958. From this it is concluded that the influence exerted by the forest had become maximum by 1958 and has remained stable since then. (Auth.)

10603. Shirer, Hampton W., John Cairns, Jr., and William T. Taller. 1968. A SIMPLE APPARATUS FOR MEASURING ACTIVITY PATTERNS OF FISHES. Water Resources Bull., 4(3): 27-43.

A sizeable body of information has accumulated which indicates that waste disposal concentrations which merely permit survival of aquatic organisms may not permit them to function properly. Aquatic resource management groups and fisheries personnel are beginning to realize that temporary survival of fish and other aquatic organisms is really meaningless if they have aberrant behavior patterns, fail to reproduce, have poor growth rates, or are not able to function properly in other respects. However, most means of assessing sublethal effects require chronic exposures to the test material and use techniques that often require considerable expenditures for equipment, space, and personnel. In addition it is frequently desirable to have some quick assessment of the biological effects of various compounds before embarking on lengthy tests to determine whether the possibility exists of functional damage when fish undergo prolonged exposure to sublethal concentrations. The apparatus described in this paper furnishes a quick, relatively inexpensive assessment of the movement patterns of fishes and the suggestion is made that changes in activity may reflect deeper physiological stress. (Authors)

10604. Rachlin, Joseph Wolfe, and Alfred Perlmutter (Dept. of Biology, New York Univ., New York City, N. Y.). 1968. FISH CELLS IN CULTURE FOR STUDY OF AQUATIC TOXICANTS. Water Research, 2(6): 409-414.

A procedure for using fish cells in culture as an additional parameter in the study of aquatic toxicants is described, and a comparison is made between the dose response of the fathead minnow and fathead minnow cells in culture, to zinc intoxication. The cells were found to be more sensitive than were the whole animals. The calculated safe concentration, based on the whole animal studies, was found to reduce the mitotic index of the cell cultures by approximately 50%. A concentration of zinc representing one-tenth of the 96 hour TL_m of the fathead minnows was found to have no effect on the cell cultures. Using these tissue culture criteria it is concluded that one-tenth of the 96 hour TL_m is a demonstrably safer concentration for determining maximum permissible concentrations than is the calculated biologically safe concentration. (Authors)

10605. Beers, Gary D., and William J. McConnell. 1966. SOME EFFECTS OF THREADFIN SHAD INTRODUCTION ON BLACK CRAPPIE DIET AND CONDITION. J. Arizona Acad. Sci., 4(2): 71-74.

10606. Sprague, J.B., and D.W. McLeese (Fish. Res. Bd. of Canada, Biological Station, St. Andrews, N.B., Canada). 1968. TOXICITY OF KRAFT PULP MILL EFFLUENT FOR LARVAL AND ADULT LOBSTERS, AND JUVENILE SALMON. *Water Research*, 2(11): 753-760.

The lethal threshold concentration of neutralized bleached kraft pulp mill effluent for juvenile Atlantic salmon (*Salmo salar* L.) is about 12-15% in fresh water. This agrees in general with work on other salmonid fish. Larval lobsters (*Homarus americanus* Milne-Edwards) are reasonably resistant to this waste, and concentrations below 10% did not greatly affect their survival in sea water. Adult lobsters in sea water are more resistant than lobster larvae or salmon parr. (Authors)

10607. Sprague, J.B., and D.W. McLeese (Fish. Res. Bd. of Canada, Biological Station, St. Andrews, N.B., Canada). 1968. DIFFERENT TOXIC MECHANISMS IN KRAFT PULP MILL EFFLUENT FOR TWO AQUATIC ANIMALS. *Water Research*, 2(11): 761-765.

Bleached kraft mill effluent (BKME) seems to contain at least two different toxic mechanisms or materials which affect aquatic animals. BKME stored under clean and quiescent conditions, lost much of its toxicity for salmon parr (*Salmo salar* L.) in one week, and all in two weeks. By contrast, it lost little toxicity to lobster larvae (*Homarus americanus* Milne-Edwards) in two weeks. Bio-oxidation of BKME for one week eliminated toxicity for salmon parr, but did not greatly change toxicity for lobster larvae. Bio-oxidation for two weeks reduced but did not eliminate toxicity to lobster larvae. A waste treatment process which reduces toxicity of BKME for one species may not protect other species. (Authors)

10608. Chaston, I. 1968. A STUDY ON THE EXPLOITATION OF INVERTEBRATE DRIFT BY BROWN TROUT (*Salmo trutta* L.) IN A DARTMOOR STREAM. *J. appl. Ecol.*, 5(3): 721-729.

It has been suggested (a) from studies on the feeding behavior of the fish and (b) from the occurrence of specific animals in both drift and diet, that invertebrate drift is exploited as a food source by brown trout. Both the techniques employed in this assessment of exploitation can be criticized on the grounds that the observer has no control over the feeding behavior of the fish. A control was applied in this present study by placing the fish in metal tanks so that any material found in the stomachs could only have been obtained from the water column. The occurrence of animals of benthic origin in the stomachs was rarely recorded and thus it appeared that either the fish was not feeding from drift or that their behavior was altered by the experimental conditions. During experiments in the summer, however, it was found that terrestrial material occurred in the stomachs in an amount similar to that found in unrestrained fish, thus suggesting that the fish were feeding normally while in the tanks. Therefore the results suggested that the aquatic component of invertebrate drift is not exploited as a food source by brown trout. (Auth. summ.)

10609. MacCrimmon, Hugh R., and T. L. Marshall (Dept. of Zoology, Univ. of Guelph, Guelph, Ont., Canada). 1968. WORLD DISTRIBUTION OF BROWN TROUT, (*Salmo trutta*). *J. Fish. Res. Bd. Canada*, 25(12): 2527-2548.

During the past century the Eurasian and North African range of the brown trout, *Salmo trutta* L., has been extended to include discontinuous populations on all continents except Antarctica. Primary factors affecting the establishment of naturalized populations are water temperature, precipitation, and suitable spawning grounds. Any future major expansion in the world distribution of the brown trout, with the possible exception of Asia, is unlikely. (Authors)

10610. Idler, D.R., and B.J. Szeplaki (Fish. Res. Bd. of Canada, Halifax Lab., Halifax, N.S., Canada). 1968. INTERRENALECTOMY AND STRESS IN RELATION TO SOME BLOOD COMPONENTS OF AN ELASMOBRANCH (*Raja radiata*). *J. Fish. Res. Bd. Canada*, 25(12): 2549-2560.

From the literature there was a doubt as to whether interrenalectomy would result in elevated plasma potassium levels in a elasmobranch; in this study, no

elevation was observed by comparison with sham-operated thorny skate (Raja radiata) held in sea water for up to 44 days post-operative. Blood calcium levels were significantly elevated in the interrenalectomized animals between 13 and 23 days but the increase was only 10%. There was no change in osmolality, sodium chloride, magnesium, or urea which can be attributed to interrenalectomy. Note-worthy was the manner in which both sham and interrenalectomized animals were able to maintain plasma electrolyte levels during the long period of starvation after surgery. Whenever significant changes occurred during the course of the experiment, sham and interrenalectomized fish were similarly affected, apart from the exception noted for calcium. Plasma urea levels were significantly depressed after interrenalectomy when the skates were held in a 3:1 mixture of sea water:fresh water for 7-9 days. The same trend was observed for sham-operated animals but the decrease was not significant. Normal animals maintained plasma urea in 75% sea water but not in 60% sea water. (Authors)

10611. Semakula, S. N., and P. A. Larkin (Inst. of Fish. and Dept. of Zoology, Univ. of British Columbia, Vancouver, B. C., Canada). 1968. AGE, GROWTH, FOOD, AND YIELD OF THE WHITE STURGEON (Acipenser transmontanus) OF THE FRASER RIVER, BRITISH COLUMBIA. J. Fish. Res. Bd. Canada, 25(12): 2589-2602.

For white sturgeon taken incidentally in the salmon gillnet fishery in the Fraser River during the summer of 1962, pectoral fin ray sections indicated that over three-quarters were fish aged 9-16 years. Gillnets for salmon apparently select sturgeon over a size range between 30 and 60 inches. Back-calculation of size attained at previous ages indicated that after attaining a length close to 20 inches by age 5, the sturgeon grow about 2 inches per year to about age 25. Limited data from pectoral fin ray sections suggest that age at first spawning is from 11 to 22 years for males, and from 11 to 34 for females. Subsequent spawning is apparently at intervals of 4-9 years. Fraser River sturgeon are more piscivorous than has been recorded for white sturgeon and other sturgeon species elsewhere, about one-half of the stomachs containing fish, especially eulachons. The age distribution in the catch, though biased by selection, was used to estimate rates of natural and fishing mortality. The eumetric fishing curve suggests that present yield could be increased by a greater size at first capture, particularly if the natural mortality rate is as low as 0.05. The history of the sturgeon fishery suggest that sustainable yield could exceed 100,000 lb per year. The commercial landings in recent years average 30,000-40,000 lb. The sport fishery may take an additional 20,000-30,000 lb. Sustained yield in the circumstances of the present fishery could be 80,000 lb per year, about 25% more than the present catch. Some recommendations are made for management, stressing the importance of protection of an annual spawning population of 300-600 females. (Authors)

10612. Hart, J. S. (Dept. of Zoology, Univ. of Toronto, Toronto, Ont., Canada). 1968. RESPIRATION OF THE WINNIPEG GOLDEYE (Hiodon alosoides). J. Fish. Res. Bd. Canada, 25(12): 2603-2608.

The respiratory metabolism of groups of goldeye was measured during rest and sustained swimming activity at 5, 10, and 15° C under conditions of continuous reduction in oxygen by the metabolism of the fish. The oxygen consumption fell progressively during swimming at all temperatures indicating dependence of metabolism on oxygen supply at all pO₂ levels. During rest the oxygen consumption was relatively independent of pO₂ until certain critical levels were reached. Respiration became markedly limited by CO₂ in the medium when the pCO₂ exceeded 50 mm Hg. It is apparent that survival possibilities of goldeye would be limited by pO₂ and pCO₂ between 20-40 mm Hg during the winter. (Auth.)

10613. Kemmerer, Andrew J., Joseph Glucksman, Phillip A. Stewart, and William J. McConnell (Arizona Coop. Fish. Unit, Univ. of Arizona, Tucson, Ariz.). 1968. SOME PRODUCTIVITY RELATIONS IN SEVEN FISHING IMPOUNDMENTS IN EASTERN ARIZONA. J. Arizona Acad. Sci., 5(2): 80-85.

10614. Hulburt, Edward M. (Woods Hole Oceanogr. Inst., Woods Hole, Mass.). 1968. STRATIFICATION AND MIXING IN COASTAL WATERS OF THE WESTERN GULF OF MAINE DURING SUMMER. J. Fish. Res. Bd. Canada, 25(12): 2609-2621.

In the summers of 1966 and 1967, very low surface temperatures, about 11° C, and weakly stratified water occurred along the western coast of the Gulf of Maine at Cape Nedick, in the Sheepscot River, and off Vinalhaven Island at the mouth of Penobscot Bay. Moderately low temperatures, about 13° C, were found often between the islands of Casco Bay. These low temperatures indicate an active vertical mixing, associated with tidal currents, that transports water warmed at the surface downward and cold water upward. Where tidal mixing is reduced, offshore from Cape Ann and in the landward confines of Casco Bay, surface temperatures over 17° C and pronounced stratification occurred. When these high temperatures were observed off Cape Ann, the weather was sunny and calm, or a light wind caused very little mixing. Within Casco Bay temperatures of 17° C or more were observed during a period when fogs were prevalent, allowing heating in clear spells in the daytime and a minimum of cooling at night. (Auth.)

10615. Mounib, M. S., P. C. Hwang, and D. R. Idler (Fish. Res. Bd. of Canada, Halifax Lab., Halifax, N. S., Canada). 1968. CRYOGENIC PRESERVATION OF ATLANTIC COD (*Gadus morhua*) SPERM. J. Fish. Res. Bd. Canada, 25(12): 2623-2632.

Cryogenic preservation of cod sperm, with retention of fertilizing capacity, was achieved. Sperm were deep frozen to -79° C or -196° C in the presence of protecting agents. Of the conditions tested, most satisfactory freezing was accomplished in a mixture containing 1 part semen and 3 parts of a medium that consisted of 40 parts 0.4 M NaCl-0.1 M glycine:8 parts of 1.3% sodium bicarbonate:10 parts of glycerol. A freezing rate of 5° C per minute was more successful than one of 1° C per minute. When frozen sperm were stored at -196° C for periods up to 60 days the average fertility was 36 ± 12% (seven samples) compared with 79 ± 6% (seven samples) for fresh sperm on the same batch of eggs. Successful storage of cod sperm at -79° C for a year was achieved. (Authors)

10616. McDermott, L. A., and A. H. Berst (Univ. of Guelph, Dept. of Microbiology, Guelph, Ont., Canada). 1968. EXPERIMENTAL PLANTINGS OF BROOK TROUT (*Salvelinus fontinalis*) FROM FURUNCULOSIS-INFECTED STOCK. J. Fish. Res. Bd. Canada, 25(12): 2643-2649.

Preliminary sampling revealed the presence of furunculosis disease in the resident brook trout population of the southern Ontario trout stream used in this study. Two plantings of marked yearling brook trout were made in the study area in 1966; one in the spring, and the other in the fall. The spring planting consisted of 1,000 brook trout with a predetermined incidence of furunculosis infection and an equal number of trout with no evidence of infection. The fall planting consisted of 2,000 brook trout with a known incidence of furunculosis infection. The stream was electrofished periodically during the 2-year period after the first planting. A total of 445 brook trout (140 of the planted hatchery stock, and 305 resident trout) and 127 fish of associated species were captured and examined for the presence of *Aeromonas salmonicida*, causative agent of furunculosis. Recovery rates of the "infected" and "noninfected" stocks of brook trout were similar, and there was no evidence of transmission of *A. salmonicida* from the infected fish to the control fish, nor the resident population of brook trout and other species of fish captured. (Authors)

10617. Wilkins, N. P. (Dept. of Agriculture and Fisheries for Scotland, Marine Lab., Aberdeen, Scotland). 1968. MULTIPLE HAEMOGLOBINS OF THE ATLANTIC SALMON (*Salmo salar*). J. Fish. Res. Bd. Canada, 25(12): 2651-2653.

The haemoglobins of over 500 salmon of different lengths, from Scotland, Greenland, and Canada have been analysed by vertical starch-gel electrophoresis at pH 8.1. Complex ontogenetic variations, involving an initial increase and later reduction in the number of fractions evident, have been observed among the anodally

migrating haemoglobins. The variations observed have been correlated with changes in length, and the complete development of the anodal haemoglobin complex from the single fraction of small fish to the nine-fraction pattern of adults is outlined. The individual haemoglobin fractions appear to represent structurally distinct molecules whose regulated occurrence at different phases of the life cycle is discussed at the individual and population levels. (Auth.)

10618. Day, Donald S., and William G. Percy (Bur. of Commercial Fisheries, Seattle, Wash.). 1968. SPECIES ASSOCIATIONS OF BENTHIC FISHES ON THE CONTINENTAL SHELF AND SLOPE OFF OREGON. J. Fish. Res. Bd. Canada, 25(12): 2665-2675.

Four species associations of benthic fishes found off the coast of Oregon within the depth interval from 40 to 1,829 m were characterized by two or three most abundant species, depth range, and average sediment type. Little overlap was found among species associations because many species had maximum abundance or were found only in one association. When a species occurred in more than one association, different sizes of fish were often found. Species on the lower continental slope had the broadest depth range, and a few species were found only in the deepest association. Sixty-seven species of bottom fishes representing 21 families were collected, but 86% of the total number of fishes were from the families Pleuronectidae, Scorpaenidae, and Bothidae. (Authors)

10619. Anderson, John M. (Dept. of Biology, Carleton Univ., Ottawa, Ont., Canada). 1968. EFFECT OF SUBLETHAL DDT ON THE LATERAL LINE OF BROOK TROUT, Salvelinus fontinalis. J. Fish. Res. Bd. Canada, 25(12): 2677-2682.

The lateral line nerve of brook trout responds to an abrupt low-frequency pressure wave, generated by a falling drop of water hitting the water surface, by a relatively short high-frequency burst of large spikes. The burst duration has a negative temperature coefficient. Exposure of trout for 24 hours to DDT, ranging from 0.1 to 0.3 ppm, renders the lateral line nerve hypersensitive to the experimental stimulus; in particular there is a marked increase, especially at the colder temperatures, in the negativity of the temperature coefficient of the burst durations. The results are discussed in general terms, as well as specifically in relation to other laboratory work which shows that sublethal DDT affects behavioral responses of fish to temperature. (Auth.)

10620. Withler, F. C., and R. B. Morley (Fish. Res. Bd. of Canada, Biological Station, Nanaimo, B. C., Canada). 1968. EFFECTS OF CHILLED STORAGE ON VIABILITY OF STORED OVA AND SPERM OF SOCKEYE AND PINK SALMON. J. Fish. Res. Bd. Canada, 25(12): 2695-2699.

10621. Reisman, Howard M. (Div. of Biological Sciences, Cornell Univ., Ithaca, N. Y.). 1968. REPRODUCTIVE ISOLATING MECHANISMS OF THE BLACKSPOTTED STICKLEBACK, Gasterosteus wheatlandi. J. Fish. Res. Bd. Canada, 25(12): 2703-2706.

10622. Gosselin-Rey, C., G. Hamoir, and R. K. Scopes (Dept. of General Biology, Inst. Ed. Van Beneden, Univ. of Liege, Liege, Belgium). 1968. LOCALIZATION OF CREATINE KINASE IN THE STARCH-GEL AND MOVING-BOUNDARY ELECTROPHORETIC PATTERNS OF FISH MUSCLE. J. Fish. Res. Bd. Canada, 25(12): 2711-2714.

10623. Scopes, R. K., and C. Gosselin-Rey (Agricultural Research Council, Meat Research Inst., Langford, Nr. Bristol). 1968. POLYMORPHISM IN CARP MUSCLE CREATINE KINASE. J. Fish. Res. Bd. Canada, 25(12): 2715-2716.

10624. Garside, E. T., and C. M. Jordan (Dept. of Biology, Dalhousie Univ., Halifax, N. S., Canada). 1968. UPPER LETHAL TEMPERATURES AT VARIOUS LEVELS OF SALINITY IN THE EURYHALINE CYPRINODONTIDS Fundulus heteroclitus AND F. diaphanus AFTER ISOSMOTIC ACCLIMATION. J. Fish. Res. Bd. Canada, 25(12): 2717-2720.

10625. Pienaar, L.V., and W.E. Ricker (Fish. Res. Bd. of Canada, Biological Station, Nanaimo, B.C., Canada). 1968. ESTIMATING MEAN WEIGHT FROM LENGTH STATISTICS. J. Fish. Res. Bd. Canada, 25(12): 2743-2747.

10626. McConnell, William J. (Arizona Coop. Fish. Unit., Univ. of Arizona, Tucson, Ariz.). 1968. LIMNOLOGICAL EFFECTS OF ORGANIC EXTRACTS OF LITTER IN A SOUTHWESTERN IMPOUNDMENT. Limnol. & Oceanogr., 13(2): 343-349.

Watershed litter in semiarid southeastern Arizona is relatively unleached, and the accumulation of a year or more is occasionally delivered to lakes within the first few days of the summer rainy season. Pena Blanca Lake received at least 750 g/m² of oak litter during the summer of 1959. About 329 kg cal/m² were delivered to the lake in oak litter extracts of which 26% were probably from carbohydrates, 54% from phenolic compounds, and 20% from unidentified compounds. Oak leaf extracts were experimentally effective as an energy source for microorganisms used as food by filter-feeding organisms (*Xenopus laevis*) and snails. Efficiency of the extract-microorganisms-*Xenopus* and snail food chain was 3.28%. Based on an estimated ecological efficiency of 0.56% for the food chain: litter extract-microorganisms-zooplankton-young *Micropterus salmoides*, *Micropterus* biomass production may have been increased 0.4 g/m² by organic components in oak litter extracts contributed to Pena Blanca Lake in 1959. This increase represents 16.7% of the average annual fish harvest for 1959, 1960, and 1961. (Auth.)

10627. Coevering, Jack Van. 1969. COHO — THE SECOND YEAR. Field and Stream, 161(3): 48-49, 112-117.

The 1968 salmon fishing in the Great Lakes differed from the previous year but continued to be the big fishing story. In 1967 the best fishing was in September but in 1968 it was in August. The salmon came to the rivers earlier, were smaller and reportedly did not fight as they had in 1967. The source of the salmon eggs was different, they were taken earlier, and the young were planted sooner. Rough weather and warm waters contributed to the poorer fishing. Although the fishing was poorer the total sport catch rose from about 30 thousand in 1967 to some 100 thousand in 1968. Wider distribution of stocked salmon in 1969 is expected to prevent the past concentrations of fishermen. More sea lamprey scars were noted on the fish in 1968 than in 1967. The interaction of sea lampreys, salmon, lake trout, and alewives is still uncertain.

10628. Burnet, A.M.R. (Fisheries Div., Fisheries Lab., Christchurch, N.Z.). 1968. A STUDY OF THE RELATIONSHIPS BETWEEN BROWN TROUT AND EELS IN A NEW ZEALAND STREAM. New Zealand Marine Dept. Fisheries Technical Report No. 26. 26 p. Illus.

A mile long stretch of the south branch of the Waimakariri River, was isolated by a fish trap, and the numbers and weight of the trout and eel populations determined. Eels exceeded trout both in number and by weight. In the spring of 1959 an effort was made to remove as many eels as possible. Eel control resulted in a marked increase in the trout population number with a consequent increase in density and an associated decrease in growth rate. As the growth rate of the trout decreased so the "condition" of the trout declined from good to poor. The downstream movement of trout, measured at the fish trap, accounted for only 12% of the fish which disappeared between the annual censuses. (Auth. summ.)

10629. Hardy, C.J. (Fisheries Div., Fisheries Lab., Christchurch, N.Z.). 1968. FRESHWATER FISHERIES FIELD TECHNIQUES—TAGGING; TRANSPORTATION; MORTALITY AND DRIFT SAMPLING. New Zealand Marine Dept. Fisheries Technical Report No. 27. 35 p. Illus.

10630. Summerfelt, Robert C., and William M. Lewis. 1967. REPULSION OF GREEN SUNFISH BY CERTAIN CHEMICALS. J. Water Pollut. Contr. Fed., 39(12): 2030-2038.

10631. Kirsche, W. (Anat. Inst., Humbolt Univ., Berlin, Germany). 1966. BIOMETRICAL INVESTIGATIONS ON THE NUCLEUS NERVI OCULOMOTORII FROM FRESHWATER BONY FISH IN RESPECT TO THEIR BEHAVIOR. (Biometrische untersuchungen am nucleus nervi oculomotorii von süsswasser-knochen-fischen in beziehung zur verhaltensweise). Biol. Zentralbl., 85(5): 578-596; Biological Abstracts, 48(22): Abst. No. 109831. 1967.

A comparison of teleosts differing in use of vision in food-getting and swimming indicates that the size of the oculomotor nucleus is related to behavior. Nucleus-body size quotient was larger in sighted fish of prey Salmo gairdneri Rich., Perca fluviatilis L., Esox lucius L. and a sighted specimen of Cyprinidae, Leveiscus idus L. The smallest values were associated with blindness or with fish of low visual faculty Anoptichthys jordani Hubbs and Innes, Anguilla anguilla (L.), Lota lota (L.). Similar results were also obtained using median area and frontal section data. No significant correlation was found for the median area of the nucleus and brain length. The behavior of fishes and not their biosystematic position is decisive for the measured quotients and quantities. --D.S. Grosch.

10632. Kanid'ev, A.N. 1966. SURVIVAL RATE OF JUVENILE CHUM SALMON Oncorhynchus keta (Walbaum) IN RIVERS. (Stepen'vyzhivaniya molodi kety Oncorhynchus keta (Walbaum) v reke). Vop. Ikhtiol., 6(4): 708-719. Illus.; Biological Abstracts, 48(22): Abst. No. 109986. 1967.

The downstream migration of juvenile chum salmon (Oncorhynchus keta) released in the Yasnomorka River continues for more than 1-1/2 months. Night migration, timidity, feeding by day in shallows, schooling behavior, etc. are characteristic of the juveniles, i.e., all those traits which characterize the behavior of juveniles of natural spawning during river life. Most deaths of the migrating juvenile chum salmon are caused by the predatory fishes kundzha (Salvelinus leucomaenis), Dolly Varden trout, and cherry salmon (Oncorhynchus masu) and by a drop of the river level. The total death of the juvenile chum salmon during the downstream migration period was a bit more than 9%. Greatest damage was inflicted by the kundzha, then the Dolly Varden and cherry salmon. The smallest population of predators during the migration period of the chum salmon was observed at the end of June, and their minimal concentration in the lower reaches of the river. The level of the river is stabilized by the end of the migration period. As a consequence of the identical hydrological regime of rivers and the composition of predators on the southwestern coast of Sakhalin, the magnitude of the death of released juvenile chum salmon is approximately the same as their death in the Yasnomorka River. Taking into account the size of the predators and their number and distribution in time and along the length of the river, migrant juvenile chum salmon for protection, should be grown to larger size and released in the lower reaches of the river at the end of May or beginning of June. --J. Slep.

10633. Kipper, Z.M., and I.V. Mileiko. 1967. FISHWAYS IN HYDRO DEVELOPMENTS OF THE USSR. v+57 p. Illus. Israel Program for Scientific Translations: Jerusalem, Israel. Pr. \$3.00; Biological Abstracts, 48(22): Abst. No. 109987. 1967.

This booklet discusses the operation, design, and construction of fish passages at the site of hydropower plants. Thirteen types of fishways, fish lifts, and fish passages are described. The conclusion contains a list of suggestions essential in the correct design of fish passages. The booklet is translated from Russian. It concludes with a short bibliography.

10634. Libosvasky, Jiri (Inst. Vertebrate Zool., Czech. Acad. Sci., Brno, Czech.). 1966. AGE COMPOSITION AND SIZE OF FISH WITHIN ONE AGE GROUP IN ELECTRO-FISHING SAMPLES. Zool. Listy., 15(4): 381-385. (Czech. summ.); Biological Abstracts, 48(22): Abst. No. 109989. 1967.

Successive catches of brown trout (Salmo trutta m. fario L.) obtained by electro-fishing in the same stream section for two years, were examined to find out to what extent the size selectivity of this kind of sampling influences the age composition of fish in catches and whether or not the bigger fish within the same age are removed sooner than the smaller ones. In brown trout one had a 3/4

chance that the second and third fishing of the same section does not bring any substantial change in the age distribution of the total catch. Bigger fish of the same age group were generally not removed sooner than the smaller ones. This suggests that smaller numbers of fish captured by using the recapture method, or when only one fishing run is made, do not necessarily introduce a distinct bias into the growth results. (Auth.)

10635. Saunders, Dorothy Chapman (Cape Haze Marine Lab., Sarasota, Fla.). 1966. DIFFERENTIAL BLOOD CELL COUNTS OF 121 SPECIES OF MARINE FISHES OF PUERTO RICO. Trans. Amer. Microsc. Soc., 85(3): 427-449. Illus.; Biological Abstracts, 48(22): Abst. No. 110847. 1967.

Differential blood counts were made from heart or artery blood smears of 601 marine fishes from Puerto Rico, belonging to 121 species of 45 families and 12 orders. The first 100 red corpuscles seen of the erythrocytic series on each slide were counted and listed as either erythroblasts or erythrocytes. Mature erythrocytes were also measured and their mean values obtained in microns for length and width for each fish species. The first 100 white corpuscles seen on each slide were counted and listed under the following categories: 1) Elasmobranchs: hemocytoblasts, monocytes, lymphocytes, thrombocytes, and any of three types of granulocytes (eosinophils, neutrophils, heterophils); 2) Teleosts: large and small hemoblasts, macrophages, large and small lymphocytes, thrombocytes, and any of three types of granulocytes (eosinophils, basophils, neutrophils). The mean percentage of each type of white corpuscle present was calculated for each fish species. A number of red corpuscle counts was made with a Neubauer hemocytometer. Photomicrographs were made of typical cell types of both elasmobranchs and teleosts. Basophils were found in five species of teleosts: Synodus intermedius, Holocentrus ascensionis, H. rufus, Caranx bartholomaei, and Dactylopterus volitans. Eosinophils were present in 70 species of fishes, including each individual elasmobranch and 65 of the 116 species of teleosts. Thrombocytes were the type of leucocyte found in the greatest numbers, and small lymphocytes were next. Some fish species had a relatively low percentage of leucocytes to erythrocytes. A large number of unusual "ring cells" were found in the two specimens studied of Diodon holacanthus, the balloonfish. In shape and appearance they resembled the "secretory granulocytes" described by Downey (1909) from the blood of the ganoid fish, Polyodon spathula, although there was no evidence from the Diodon material that they were derived from granulocytes. (Auth.)

10636. Dunbar, C. E., and Ken Wolf (Bur. of Sport Fisheries and Wildlife, Kearneysville, W. Va.). 1966. THE CYTOLOGICAL COURSE OF EXPERIMENTAL LYMPHOCYSTIS IN THE BLUEGILL. J. Infect. Dis., 116(4): 466-472. Illus.; Biological Abstracts, 48(22): Abst. No. 112728. 1967.

Lymphocystis disease was studied in bluegills at 25° C, and virus multiplication was correlated with cytological change. Following inoculation, residual virus declined and a significant drop occurred by the third day. During this time cells enlarged and became basophilic. Eclipse probably occurred from the third to about the fifth day, and the titer (presumably new virus) returned to about its initial level on the sixth day. The production of new virus followed the appearance of cytoplasmic inclusions on day 5, and it was most rapid during the time inclusion substance enlarged and differentiated. Maximum titer was attained at about 2 weeks, but cells continued to enlarge for an additional 2 weeks. (Authors)

10637. Schell, Stewart C. (Dept. Biol. Sci., Univ. Idaho, Moscow, Ida.). 1967. THE LIFE HISTORY OF Phyllodistomum staffordi Pearse, 1924 (TREMATODA: GEORGODERIDAE LOOSS, 1901). J. Parasitol., 53(3): 569-576. Illus.; Biological Abstracts, 48(22): Abst. No. 114037. 1967.--

Mother and daughter sporocysts and cystocercous cercariae develop in the fingernail clam, Musculium ryckholti. Following emergence, the cercariae are eaten by naiads of damselflies and trichopterous larvae in which they encyst. The adult Phyllodistomum staffordi develops in the urinary bladder of the brown bullhead, Ameiurus nebulosus, which acquires the parasite by eating the infected insects. (Auth.)

10638. Division of Fish Hatcheries (Bur. of Sport Fisheries and Wildlife, Wash., D. C.). 1967. PROPAGATION AND DISTRIBUTION OF FOOD FISHES FOR THE CALENDAR YEARS 1963 AND 1964. U. S. Fish and Wildlife Service Fish Distribution Report No. 1. Biennial.

This report is a continuation of a series of publications issued since 1872. The report consists of statistics, listed in table form, on the quantities and types of the following: fishes and fish eggs distributed; fishes and fish eggs assigned to Federal agencies; fish and fish eggs assigned to State fish commissions; fishes and fish eggs distributed by hatcheries; and a summary, by States, of distribution of fishes and fish eggs. There is a listing of common and scientific names of the fishes used in this publication.

10639. Rees, H. (Dept. Agr. Bot., Univ. Coll. Wales, Aberystwyth, Wales, UK). 1967. THE CHROMOSOMES OF *Salmo salar*. *Chromosoma*, 21(4): 472-474. Illus.; Biological Abstracts, 48(23): Abst. No. 114729. 1967.

A new chromosome number, $2n = 58$, is reported for *Salmo salar*, the Atlantic salmon. The complement comprises 8 pairs of metacentrics, 21 pairs of acrocentrics. The question of variation in chromosome numbers for different salmon stocks is very briefly discussed. (Auth.)

10640. Fleishman, D.G., E.S. Romanova, and S.M. Baklanova. 1965. SOME DATA ON THE RADIOACTIVITY OF BIOSPHERE OBJECTS IN THE PARATUNKA RIVER BASIN. (Nekotorye dannye o radioaktivnosti ob'ektov biosfery v basseine r. Paratunki). *Vop. Khtiol.*, 5(4): 738-742. Illus.; Biological Abstracts, 48(23): Abst. No. 114952. 1967.

The material was collected and analyzed in July-August 1962. In fishes migrating from the Pacific to their spawning grounds natural radioactivity was relatively low. Cs^{137} activity in soft tissues was 5-8% of the natural activity due to Ca^{40} . Radioactivity was substantially lower than that observed in farm animals. Substantial concentrations of radioisotopes were detected in permanent inhabitants of Lake Dal'noe. Thus, the Sr^{90} content in juvenile coho salmon and in "dwarfs" was 10-15 times higher than in fishes which came to Lake Dal'noe from the sea. This phenomenon is explained by the fact that in small water masses the concentration of radioactive fallout is usually greater than in the ocean. --D.M. Cutler.

10641. Dawson, C.E. (Gulf Coast Res. Lab., Ocean Spring, Miss.). 1966. ADDITIONS TO THE KNOWN MARINE FAUNA OF GRAND ISLE, LOUISIANA. *Proc. Louisiana Acad. Sci.*, 29(1): 175-180; Biological Abstracts, 48(23): Abst. No. 115160. 1967.

As a result of a 16-month ecological study of Gulf of Mexico waters, 84 invertebrate and 40 fish species are listed, together with bathymetric data, as new records for the Grand Isle, Louisiana, region. (Auth.)

10642. Herrington, Roscoe B., and S. Ross Tocher (Forest Service, U.S. Dept. of Agriculture, Ogden, Utah). 1967. AERIAL PHOTO TECHNIQUES FOR A RECREATION INVENTORY OF MOUNTAIN LAKES AND STREAMS. U.S. Forest Service Res. Pap. Int. 37. 1-21. Illus.; Biological Abstracts, 48(23): Abst. No. 115197. 1967.

Describes results of aerial photo techniques tested in Utah to measure the characteristics of mountain lakes and streams. Compares accuracy of photo determination of lake depth with field measurements of lake depth. Procedures for all photo measurements needed to conduct lake and stream inventory are explained. (Authors)

10643. Clugston, James P. (Game and Freshwater Fish Comm., Leesburg, Fla.). 1966. CENTRARCHID SPAWNING IN THE FLORIDA EVERGLADES. *Quart. J. Fla. Acad. Sci.*, 29(2): 137-142; Biological Abstracts, 48(23): Abst. No. 115226. 1967.

Observations of spawning were made between December 1960 and July 1964 in Conservation Area 2, Broward and Palm Beach Counties, Florida. The large-mouth bass (*Micropterus salmoides*) was first of the centrarchids to spawn each

year in South Florida. Largemouth bass spawning usually commenced when the water cooled to almost 60° F during mid-December to mid-January. Spotted sunfish (Lepomis punctatus) were first seen spawning when the mid-day water temperature was 64° F, and bluegill (L. macrochirus) and redear sunfish (L. microlophus) started spawning in late February or early March when the water temperature approached 70° F. The observed maximum spawning seasons varied from 4 months for the largemouth bass to 8 months for the spotted sunfish. November was the only month in which no centrarchid spawning was observed. (Auth.)

10644. Coche, A. G. (Oregon State Univ. Corvallis, Oreg.). 1967. OSMOTIC REGULATION IN JUVENILE Oncorhynchus kisutch (Walbaum). I. THE SALINITY TOLERANCE OF 50-DAY OLD FRY. *Hydrobiologia*, 29(3/4): 426-440. Illus. (French summ.); *Biological Abstracts*, 48(23): Abst. No. 115227. 1967.

The experiments carried out suggests a tolerance to 18% salinity for fish fry 44 days old. Young coho salmon 59 days old survived in 22%. Another experiment tested the effect of acclimatizing 59 day old fry for 9 days to 21% salinity. These then survived the next 7 days at 28% salinity. The direct transfer of 59 day old fry from 24% salinity to fresh water could be entirely successful. (Auth. summ.)

10645. Department of Agriculture and Fisheries for Scotland. 1965. SCOTTISH SALMON AND TROUT FISHERIES. 111 p. Illus. Map. Her Majesty's Stationery Office: Edinburgh, Scotland. Pr. \$1.60; *Biological Abstracts*, 48(23): Abst. No. 115230. 1967.

This report is distributed in the United States by the British Information Service, 845 Third Avenue, New York 10022. This is a report to the Secretary of State for Scotland. It gives detailed information on the regulation of fishing for salmon and migratory trout and an interim finding on the subject of drift-net fishing for salmon in the sea. The booklet also covers the establishment of the Scottish Anglers Trust, and the institution of licensings and rating schemes which will contribute to revenue income.

10646. Hyder, M. (Dept. Zool., Univ. Coll., Nairobi, Kenya). 1966. NEW TECHNIQUES FOR THE ARTIFICIAL BROODING OF EGGS AND YOUNG OF ORAL-BROODING Tilapia SPECIES. *East Afr. Agr. Forest J.*, 32(2): 175-177.

Three new techniques for the artificial brooding of eggs and young of oral brooding Tilapia species have been described and their significance in opening up new vistas of experimental work on the young of these fish are assessed. (Auth.)

10647. Russell, Eleanor M. (Zool. Dept., Univ. New S. Wales, Sydney, Australia). 1966. AN INVESTIGATION OF THE PALATABILITY OF SOME MARINE INVERTEBRATES TO FOUR SPECIES OF FISH. *Pacific Sci.*, 20(4): 452-460; *Biological Abstracts*, 48(23): Abst. No. 115271. 1967.

The palatability of 48 species of marine invertebrates was determined, of which 24 species were found to be unpalatable to 4 test species of fish (Pelates quadrilineatus, Torquigener hamiltoni, Gambusia affinis and Carassius auratus). There was a significant difference in color distribution between palatable and unpalatable tissues. Unpalatability remained when texture, color pattern, and to some extent color, were masked by presenting the tissue in a gelatin base. It is suggested that chemical defense mechanisms are widespread among invertebrates; and an important factor in determining what fish eat. (Auth.)

10648. Shishanina, A. D. 1959. DATA ON THE ETIOLOGY AND PATHOGENESIS OF WHITE SPOT DISEASE OF SALMONIDAE LARVAE. (Materialy po etiologii i patogenezu belopyatnistoi bolezni lichinok lososevykh ryb). *Tr. Soveshch. Ikhtiolo. Komis. Akad. Nauk SSSR* 9. 94-98; *Referat. Zhur.*, *Biol.*, 1960, No. 100144. (Translation); *Biological Abstracts*, 48(23): Abst. No. 115274. 1967.

Confirmation of association of the white spot disease with impaired conditions of incubation and rearing of larvae. Histological examination showed that establishment and development of organs are greatly retarded in sick larvae. In addition, absorption of the yolk sac of sick larvae is delayed. The liver cells are destroyed and replaced by fat droplets. The larvae die of toxic dystrophy. The white inclusions result from a pathophysiological process. --Courtesy NSF (PL 83-480) 1963.

10649. Skripchenko, E.G. 1965. FOOD AND FEEDING INTERRELATIONSHIPS OF FISHES IN THE NOVOSIBIRSK RESERVOIR. (Pitanie i pishchevye vzaimootnosheniya ryb Novosibirskogo vodokhranilishcha). Uch Zap Tomskii Univ., 51. 154-160. From: Ref. Zh., Biol., 1966, No. 41116. (Translation); Biological Abstracts, 48(23): Abst. No. 115277. 1967.

The food of 10 species of fish was investigated. In 3 predators (pike, nelma, perch) there was a preponderance of fish, while the diet of the remaining species consisted basically of tendipedid larvae and cladocerans. Algae and macrophytes were found to occupy a prominent place in the food of dace, roach and ide; planktonic organisms, in the food of juvenile perch, bream, roach, dace; and tendipedid larvae in the food of adult perch, ide, bream, sterlet, ruffe and sturgeon. The fish exhibited similar feeding spectra, a circumstance indicating the absence of food-competition because of the abundant food supply. This fact is confirmed by the rapid growth rate of the fish and by the high indices of fullness of their intestines and stomachs.

10650. Spanovskaya, V.D., V.A. Grigorash, and T.N. Lyagina (Moscow State Univ., Moscow, USSR). 1966. STRUCTURE OF THE SPAWNING POPULATION AND REPRODUCTIVE CAPACITY OF THE ROACH *Rutilus rutilus* (L.) UNDER CONDITIONS OF A REGULATED FLOW. Vop. Ikhtiol., 6(4): 648-655; Biological Abstracts, 48(23): Abst. No. 115283. 1967.

The purpose of this investigation was to trace how the structure of the spawning population of the roach (*Rutilus rutilus*) changed during the first 5 years of existence of a new reservoir, to determine the relationship of the processes of death and recruitment of the roach spawning population during the same years, and to observe changes in the reproductive capacity of individual generations and populations. It was found that regulation of the flow of the Moscow River increased the availability of food for the small roach school. As a result the percentage of younger age groups in the spawning population increased. This was especially manifested in the spawning population three years after the reservoir was filled. This increase of younger age groups was due to an increase in the rate of maturation of the roach populations, entrance of early-matured, highly productive generations into the spawning school during the first years of filling the reservoir, and the accelerated death of a number of old generations. The processes of recruitment began to predominate over processes of death, and the nesting population changed from G.N. Monastyrskii's population of the III type (with the predominance of residual individual over recruitment) to a population of the II type. The reproductive capacity of the various generations was different and was determined primarily by the lifespan and quantity of eggs laid in each spawning. The overall reproductive capacity of the entire spawning population increased during the first years of filling, and the structure of the roach population approached the structure of population of fishes of the II type. --J. Slep.

10651. Tokarev, A.K. 1958. BIOLOGICAL AND HYDRODYNAMIC SOUNDS EMITTED BY FISHES. (O biologicheskikh i gidrodinamicheskikh zvukakh, izdavaemykh rybami). Tr. Vses. Nauch.-Issled. Inst. Morskogo Rybn. Khoz. i Okeanog. 36: 272-279; Referat. Zhur., Biol., 1960, No. 40139. (Translation); Biological Abstracts, 48(23): Abst. No. 115289. 1967.

It is suggested to call those sounds which are closely connected with different functions of sea organisms biological sounds. The shad produces soft barking sounds (of up to 5 sec. duration). Grey mullet produces a rare clicking. "Drummer's" sound resembles the roll of a drum or a remote pneumatic hammer (duration of sound is 3-1/2 sec. on the average). The bluefish while swimming in an aquarium produced weak fading sounds resembling separate short ringing signals "tsits-tsits-tsits-tsi-tsi-tsi". Duration of sounds approximately 3 sec. (separated by 45-60 sec. intervals). Broaker in an aquarium produced sounds, when trying to get away from a man's hands; they were quiet, rumbling of 2-3 sec. duration, resembling separate signals: "try" "try" "try". Sea robin did not acclimate well to aquarium conditions and did not produce any sounds, even when disturbed. Taken out of water it produced infrequent, short, strong sounds lasting 1-2 sec. resembling

separate sounds of a rattle, like "treak". When taken out of water, produced monotonous snoring sounds "khrrr". The atherinid when feeding on insects first produces gurgling sounds when snatching food from water surface. When swallowing, champing sounds. When the scad snatches food a champing is heard too and when it presses and swallows food, a crunch of short duration. Fish must hear the sound produced by other fish when feeding, this evidently being the reason for formation of fish concentrations when they do not see the food, but swim toward it. The larger and more active the fish, the stronger the sounds it produces. Loud hydrodynamical noises are made by fast moving fish mass. --Courtesy NSF (PL 84-480) 1963.

10652. Li, M.F., and Carol Flemming (Fish. Res. Bd. of Canada, Halifax Lab., Halifax, N.S., Canada). 1967. A PROTEOLYTIC PSEUDOMONAD FROM SKIN LESIONS OF RAINBOW TROUT (*Salmo gairdnerii*). I. CHARACTERISTICS OF THE PATHOGENIC EFFECTS AND THE EXTRACELLULAR PROTEINASE. Canadian J. Microbiol., 13: 405-416.

A fluorescent pseudomonad producing a powerful extracellular proteinase and closely resembling but not identical with *Pseudomonas fluorescens* was isolated from skin lesions of rainbow trout. Subcutaneous injection of the live organism into healthy frogs caused a condition typical of redleg disease, followed by death, and its subcutaneous injection into healthy rainbow trout caused the formation of large, necrotic, swollen areas filled with fluid. The organism was re-isolated from the deliberately infected animals and histological examinations showed a high degree of destruction of the muscular tissue in the affected areas. The pathogenic effect observed was apparently due to the extracellular bacterial proteinase. Growth of the pseudomonad was insignificant at 3° C and 37° C, was slight at 8° C, and optimal between 15° and 25° C, and the culture filtrates possessed strong proteolytic activity against casein, hemoglobin, and rainbow trout muscle albumin. The production of this proteinase was dependent on the growth of the organism and the composition of the growth medium. (Authors)

10653. Donaldson, Edward M., and J.R. McBride (Fish. Res. Bd. of Canada, Vancouver Lab., Vancouver, B.C., Canada). 1967. THE EFFECTS OF HYPOPHYSECTOMY IN THE RAINBOW TROUT *Salmo gairdnerii* (Rich.) WITH SPECIAL REFERENCE TO THE PITUITARY-INTERRENAL AXIS. Gen. Comp. Endocrinol., 9(1): 93-101.

A method for the hypophysectomy of rainbow trout (*Salmo gairdnerii*) is described. Hypophysectomy resulted in a marked atrophy of the interrenal and thyroid tissue, a cessation of spermatogenesis, and an absence of proliferation of the integument. The plasma cortisol concentration in sham hypophysectomized fish averaged 8.1 µg/100 ml. One day after hypophysectomy the cortisol concentration averaged 3.6 µg/100 ml. Plasma samples taken from 2 to 17 days after hypophysectomy had an average cortisol concentration of 1.6 µg/100 ml. Stress caused a significant increase in the plasma cortisol concentration of control fish, but not of hypophysectomized fish. Sham operated trout injected with dexamethasone 1 mg/kg intraperitoneally 20 hours prior to blood sampling had a plasma cortisol concentration identical to that of uninjected hypophysectomized fish. These data indicate that interrenal function in *S. gairdnerii* is under pituitary control and that a negative feedback mechanism probably operates between the interrenal and the pituitary. (Authors)

10654. Bailey, Jack E. (Bur. of Commercial Fisheries Biological Lab., Auke Bay, Alaska). 1969. ALASKA'S FISHERY RESOURCES—THE PINK SALMON. U.S. Fish and Wildlife Service Fishery Leaflet 619. 8 p. Illus.

Pink salmon, *Oncorhynchus gorbuscha*, also called humpback salmon, are the most abundant of the Pacific salmon in Alaska. Alaska production of pink salmon has an average wholesale value of \$28 million and constitutes more than half of the total North American catch. Female pink salmon carry about 2,000 eggs each and spawn in late summer or early fall. The resulting fry emerge the following spring and migrate directly to salt water. They spend 1 year at sea and return as 2-year-

olds to spawn and die in their native stream. Alaskan pink salmon usually spawn only a short distance from the sea; many even spawn in intertidal streambeds. Fewer than 25% of the young survive from the time of spawning until the time of emergence from the gravel. Similar low survival rates prevail during the estuarine and oceanic portions of the life cycle. Pink salmon are just over 1 inch long when they enter the sea, but they grow to an average length of about 20 inches and weigh about 4 pounds as adults. Research biologists of several agencies assist fishery managers by determining the migration paths and the factors that affect abundance of pink salmon. (Auth.)

10655. Aubin, A.E., and P.H. Johansen (Biology Dept., Queen's Univ., Kingston, Ont., Canada). 1969. THE EFFECTS OF AN ACUTE DDT EXPOSURE ON THE SPONTANEOUS ELECTRICAL ACTIVITY OF GOLDFISH CEREBELLUM. Canadian J. Zool., 47(2): 163-166.

Goldfish exposed to 1.0 ppm DDT in water for 2.5 hours show a complete loss of balance as well as an increase in the amplitude and a decrease in the frequency of the spontaneous electrical activity of the cerebellum. After 6 hours recovery in uncontaminated water they recover their balance and the cerebellar electrical activity returns to control levels. (Authors)

10656. Lam, T.J. (Dept. of Zoology, Univ. of British Columbia, Vancouver, B.C., Canada). 1969. A NEW TECHNIQUE FOR THE COLLECTION OF URINE OF SMALL FISHES AND FOR THE STUDY OF EXCHANGES OF MATERIALS VIA THE HEAD REGION. Canadian J. Zool., 47(2): 225-228.

A technique is described for the collection of urine of small fishes, such as the threespine stickleback, Gasterosteus aculeatus L., form trachurus, and for the study of exchanges of materials via the head region. It involves suspension of the fish by a rubber diaphragm just posterior to the opercula, with the head region in continuously oxygenated water and the remaining body in paraffin oil. Urine collects as drop(s) in the paraffin oil. The limitations and advantages of the technique are discussed. (Auth.)

10657. Blakeley, Wes. 1969. NEW LIFE FOR SICK STREAMS. Pennsylvania Angler, 38(4): 8-10, 46.

A semi-permanent lime neutralization plant was installed on Little Scrubgrass which was affected by an abandoned strip mine. Since then bluegills, chubs and brook trout are flourishing for several miles below the plant. Elimination of the source of pollution is the ultimate goal, but such semi-permanent treatment plants provide reclamation of streams polluted by mine drainage until this can be effected.

10658. Ebert, Verlyn W., and Robert C. Summerfelt (Dept. Zoology, Kansas State Univ., Manhattan, Kansas). 1969. CONTRIBUTIONS TO THE LIFE HISTORY OF THE PIUTE SCULPIN, Cottus beldingii Eigenmann and Eigenmann, IN LAKE TAHOE. Calif. Fish and Game, 55(2): 100-120.

Certain facets of the life history of the Piute sculpin in Lake Tahoe were studied. Data on diet, age and growth, reproduction, and parasites are presented. The most common foods of the sculpin were ostracods, green filamentous algae, chironomids, plecopterans, amphipods, cladocerans, moss capsules, and oligochaetes. Diet varied with size of fish, season, depth of capture, and collection sites. Examination of annuli on otoliths from 92 sculpins collected in November and December 1963 revealed five age groups, 0, I, II, III, and IV. The calculated mean TL in mm at the end of each year of life was 33.3, 48.9, 64.7, and 69.0 for age groups I through IV, respectively. The mean coefficients of condition were 1.05 for 417 males and 0.99 for 382 females. The length-weight relationship was $\log W = -5.244 + 3.166 \log L$. Analyses of gonosomatic ratios and egg diameters, coupled with field observations of nests, indicate that most sculpins spawn in May and June. The mean number of eggs per female was 123. Sculpins do not spawn until their second year of life. Three kinds of parasites were found: a large plerocercoid larva of the genus Ligula (Cestoidea: Diphylobothridae) in the abdominal cavity, metacercaria of a strigeoid trematode in the liver, and a microsporidian of the genus Plistophora (Cnidosporidia: Microsporida) in the body wall. (Authors)

10659. Clemens, Harold B., and Glenn A. Flittner (California Dept. Fish and Game, Terminal Island, Calif.). 1969. BLUEFIN TUNA MIGRATE ACROSS THE PACIFIC OCEAN. Calif. Fish and Game, 55(2): 132-135.

Eight bluefin tuna tagged and released in the California fishery migrated westward across the Pacific Ocean and were recaptured several years later near Japan. Tagged bluefin also have migrated eastward across the Pacific. These were released near Japan and recaptured during the following year in the California fishery. Bluefin tuna probably undertake a regular migration across the north Pacific Ocean, and Japanese and American fishermen are most likely harvesting the same bluefin resource. (Authors)

10660. Plant, Richard (California Dept. Fish and Game, Iverness, Calif.). 1969. MIGRATIONS OF STRIPED BASS OCCURRING IN TOMALES BAY. Calif. Fish and Game, 55(2): 152-154.

Recoveries of tagged fish and observations of the fishery indicate that striped bass fishing in Tomales Bay, California, is dependent on fish migrating from other areas. Nineteen tag recoveries demonstrated an interchange between Tomales Bay and the Sacramento-San Joaquin River system, suggesting that the latter was the source of most striped bass occurring in Tomales Bay. --H. K. Chadwick.

10661. Bryan, C. F., and T. R. Sopher (California Coop. Fish. Unit., Bur. of Sport Fisheries and Wildlife, Humboldt State College, Arcata, Calif.). 1969. NEW NORTHERN RECORD FOR THE THREADFIN SHAD, Dorosoma petenense (Günther), IN COASTAL WATERS OF CALIFORNIA. Calif. Fish and Game, 55(2): 155-156.

Two mature male Dorosoma petenense were collected in the spring of 1968 from Arcata Bay, the northern portion of Humboldt Bay, California. This is the northernmost record of threadfin shad in coastal waters of California. Its occurrence in Arcata Bay must be the result of either a northward coastal migration (from the San Francisco Bay area) or an unauthorized stocking. It appears that proliferation in north coastal waters, other than through emigration or stocking, will occur only if the threadfin finds suitable conditions of salinity and temperature for spawning. Such conditions may exist in the spring and summer months in freshwater tributaries of Humboldt Bay, and in many north coast streams. (Authors)

10662. Hansen, Martin J., and Thomas M. Stauffer. 1967. COMPARATIVE RECOVERY TO THE CREEL, AND BEHAVIOR OF RAINBOW TROUT STOCKED IN THE GREAT LAKES. Michigan Dept. of Conservation R & D Report No. 113. 55p.

Stocking of hatchery-reared rainbow trout in the Great Lakes may be a valuable management practice because the survivors, when they are caught by anglers, are relatively large fish. In this study, we planted 125,503 tagged legal-sized rainbow trout during 1955-59 at 27 locations along Michigan shores of the Great Lakes. Three strains of trout were used: (1) progeny of Michigan hatchery brood stock, (2) progeny of Great-Lakes-run rainbow trout and (3) progeny of sea-run rainbow (steelhead) trout from the State of Washington. Matched plants were used to study four factors that might have influenced recovery rates, namely: (1) month of planting, (2) strain of trout, (3) size of trout, and (4) location of planting (stream versus lake). These, and other plants, also provided information on behavior of rainbow trout in the Great Lakes. All recoveries of trout were reported voluntarily by anglers. An unknown number of trout were caught and not reported. Publicity on the study was not uniform geographically; thus, relative rates of returns between localities far apart do not provide valid comparisons. Returns on trout caught by anglers within the first week or two after planting could not be used as a valid part of this study since the fish were still small. Rather, we used only records on fish which had grown 3 inches or more and presumably had been in the Great Lakes for one or more growing season(s). These fish added up to 1.2% of the total planted; the rates ranged from 0.0 to 9.3% among the many localities and plantings. For the factors studied, we found: (1) May plantings produced the highest returns, (2) there was not a consistent difference in returns among the

three strains, (3) larger fish gave better returns than smaller fish, and (4) lake stocking of the Michigan hatchery strain produced better returns than did stream stocking. For the plants as a group, the fish ranged widely, and only about 50% of the recovered fish "horned" to the planted stream. In the Great Lakes, planted trout grew to an average length of 16.4 inches in one growing season, and to 21.4 inches in two growing seasons. Most trout were recovered in spawning streams during spring and autumn, and within 2 years of the planting date. (Authors)

10663. Sanford, F. Bruce (Bur. of Commercial Fisheries, Branch of Reports, U.S. Naval Air Station, Seattle, Wash.). 1967. ORGANIZING THE RESEARCH REPORT TO REVEAL THE UNITS OF RESEARCH. U.S. Fish and Wildlife Service Circular 272. 9 p.

As a research project becomes increasingly complex, the traditional outline used to report the research becomes less satisfactory. The reason is that the traditional outline tends to dismember the basic units of the research and to re-group the parts in such a manner that the whole is obscured. Suggested here is a model that will help the researcher organize his report in such a way that the basic units are kept intact and their identity is revealed regardless of how complex the research may be. (Auth.)

10664. Cleaver, Fred (Bur. of Commercial Fisheries, Columbia Fisheries Program Office, Portland, Oreg.). 1969. RECENT ADVANCES IN ARTIFICIAL CULTURE OF SALMON AND STEELHEAD TROUT OF THE COLUMBIA RIVER. U.S. Fish and Wildlife Service Fishery Leaflet 623. 5 p.

The catch of salmon and steelhead trout from fish reared in Program hatcheries increased rapidly beginning in 1964. By 1967 the benefits from operation of these hatcheries appeared to be well in excess of their costs. The Oregon moist pellet diet was the greatest single factor in providing an economically favorable operation. Further advances in hatchery efficiency are expected in the next few years. Conservation agencies believe that the catch of hatchery-produced Columbia River fall chinook salmon, coho salmon, and steelhead trout can be increased substantially and that the cost per unit of production can be decreased. (Auth.)

10665. Reigle, Norman J., Jr. (Bur. of Commercial Fisheries, Exploratory Fishing and Gear Research Base, Ann Arbor, Mich.). 1969. BOTTOM TRAWL EXPLORATIONS IN SOUTHERN LAKE MICHIGAN. U.S. Fish and Wildlife Service Circular 301. 35 p.

For 4 years the Bureau of Commercial Fisheries Exploratory Fishing and Gear Research Base at Ann Arbor, Mich., surveyed the abundance, seasonal availability, and depth distribution of various fish stocks. The alewife (Alosa pseudoharengus) and chubs (Leucichthys spp.) were taken readily with the bottom trawl. Alewives composed 51.4% and chubs 44.0% of the trawl catch. Two other commercial species, yellow perch (Perca flavescens) and smelt (Osmerus mordax), were taken occasionally in commercial amounts. The alewife stocks have increased tremendously in recent years. The poundage of alewives in the trawl catch increased each year from 17% in 1962 to 74% in 1965. Alewives exhibited pronounced seasonal movements and generally were available to bottom trawls only at specific depths. The trawls caught alewives at depths of less than 5 fathoms to over 50 fathoms. Alewives appeared to be distributed universally in the study area during most of the year but were found only in some sections in winter. Alewives were more difficult to catch between July and the end of December than during January through June. Chubs were abundant all year throughout southern Lake Michigan. Chubs were caught over a wide depth range throughout the year, although bottom trawling indicated some horizontal dispersal shoreward in summer and back to deeper water in fall. (Auth.)

10666. Willock, Thomas A. 1968. NEW ALBERTA RECORDS OF THE SILVERY AND BRASSY MINNOWS, STONECAT AND SAUGER, WITH A PRELIMINARY LIST OF FISHES OF THE MILK RIVER IN ALBERTA. Canadian Field-Naturalist, 82(1): 18-23. Illus.

10667. Kramer, David (Bur. of Commercial Fisheries, Fishery-Oceanography Center, La Jolla, Calif.). 1969. SYNOPSIS OF THE BIOLOGICAL DATA ON THE PACIFIC MACKEREL, Scomber japonicus Houttuyn (NORTHEAST PACIFIC). U.S. Fish and Wildlife Service Circular 302. 18 p.

This synopsis attempts to bring together all knowledge extant on the identity (nomenclature, taxonomy, morphology), distribution, bionomics, life history, population, fishery, and protection and management of the Pacific mackerel. (Auth.)

10668. Elliott, Joseph W. (Bur. of Sport Fisheries and Wildlife, Salmon-Cultural Lab., Longview, Wash.). 1969. THE OXYGEN REQUIREMENTS OF CHINOOK SALMON. Progr. Fish Cult., 31(2): 67-73.

The oxygen requirements of several sizes of hatchery-reared chinook salmon (Oncorhynchus tshawytscha) fingerlings were determined for 5 water temperatures ranging from 43° to 63° F. The data demonstrate that as fish increase in size, the oxygen requirements per unit of weight decrease. With a rise in temperature, oxygen requirements increase at different rates for fish of different sizes. (Auth.)

10669. MacKinnon, Daniel F. (Bur. of Sport Fisheries and Wildlife, Berlin Natl. Fish Hatchery, Berlin, N.H.). 1969. EFFECT OF MINERAL ENRICHMENT OF THE INCIDENCE OF WHITE-SPOT DISEASE. Progr. Fish Cult., 31(2): 74-78.

The incidence of white-spot disease in brook trout (Salvelinus fontinalis) fry at the Berlin National Fish Hatchery has been virtually eliminated by chemical enrichment of the mineral-deficient water. Road-grade calcium chloride added to the water supply from the eye-up stage to the feeding-fry stage successfully inhibited development of white-spot disease. (Auth.)

10670. Tiemeier, O.W., C.W. Deyoe, A.D. Dayton, and J.B. Shrable (Kansas State Univ., Manhattan, Kansas). 1969. RATIONS CONTAINING FOUR PROTEIN SOURCES COMPARED AT TWO PROTEIN LEVELS AND TWO FEEDING RATES WITH FINGERLING CHANNEL CATFISH. Progr. Fish Cult., 31(2): 79-89.

Fingerling channel catfish, Ictalurus punctatus, were stocked into twenty 1/7-acre (approx.) polyethylene-lined ponds for comparison of results from feeding: (1) rations containing marine fish meal or marine fish protein concentrate; fresh-water fish meal or freshwater fish protein concentrate; (2) rations containing 18% or 25% protein; (3) rations fed at 3.0% or at 2.5% of average fish weight daily; and (4) a ration containing marine fish protein concentrate or 2 rations containing fresh-water fish protein concentrate. After being fed from April to early in September, fish were removed, weighed, and counted. Production and efficiencies in using feed were remarkably similar in 10 ponds receiving freshwater fish products and 10 other ponds receiving marine fish products. Results from 4 ponds receiving freshwater fish protein concentrate did not differ significantly from results in 2 ponds fed marine fish protein concentrate. Ten ponds receiving feed containing 25% protein produced larger fish and more pounds of fish with a better rate of feed conversion and lower feed cost per pound of gain than 10 other ponds given feed containing 18% protein. Fish on the higher protein ration required less energy. Fish fed at 3.0% daily gained more weight per pond than fish fed at 2.5% daily, but the higher feeding rate involved more pounds of feed, greater cost per pound of gain, and more energy. (Authors)

10671. Cornick, J.W., R.V. Chudyk, and L.A. McDermott (Dept. of Microbiology, Univ. of Guelph, Guelph, Ont., Canada). 1969. HABITAT AND VIABILITY STUDIES ON Aeromonas salmonicida, CAUSATIVE AGENT OF FURUNCULOSIS. Progr. Fish Cult., 31(2): 90-93.

Using Bacto furunculosis agar, Aeromonas salmonicida could not be isolated from 2,954 vertebrate and invertebrate forms associated with the waters of 2 trout hatcheries experiencing mortalities from furunculosis, nor from samples of pond water and pond bottom from the same hatcheries. Cells of A. salmonicida survived for at least 43 days in heat-sterilized tap water stored at 4° C and 10° C, for at least 40 days in a heat-sterilized mixture of tap water and soil at these same temperatures, and for 17 to 31 days in both these environments at 20° C and 30° C.

Viable cells were present in heat-sterilized moist soil after 40 days at all 4 storage temperatures. In trout dead from intramuscular injections of A. salmonicida, this organism was recovered from the heart, liver, spleen, and kidney of all such fish after 49 days' storage at -10° C, but from only the kidney of one fish after 28 days at 4° C, and from none of the organs after 42 days at 4° C. In general, A. salmonicida was isolated most often from environments containing few, if any, other bacterial species, especially those of the genus Pseudomonas. There is evidence that some pseudomonads may be inhibiting A. salmonicida. A culture medium more selective for A. salmonicida might provide new knowledge of the habitat and viability of this bacterium. (Authors)

10672. Rachlin, Joseph Wolfe, and Alfred Perlmutter (Dept. of Biological Sciences, Lehman College of the City Univ., Bronx, New York, N.Y.). 1969. RESPONSE OF RAINBOW TROUT CELLS IN CULTURE TO SELECTED CONCENTRATIONS OF ZINC SULFATE. Progr. Fish Cult., 31(2): 94-98.

The response of rainbow trout (Salmo gairdneri) gonadal cells in culture to various concentrations of zinc was studied. A concentration of 18.0 ppm zinc reduced the mitotic index of these cells by approximately 70%. Concentrations of zinc between 1.8 ppm and 10.0 ppm had no effect on the mitotic index of the cultures, whereas 32.0 ppm zinc completely inhibited mitosis. The relation between these values and previously determined values for fathead minnow (Pimephales promelas) cells in culture is discussed. (Authors)

10673. Klein, W.D., and L.M. Finnell (Fisheries Research Center, Colorado Game, Fish and Parks Dept., Ft. Collins, Colo.). 1969. COMPARATIVE STUDY OF COHO SALMON INTRODUCTIONS IN PARVIN LAKE AND GRANBY RESERVOIR. Progr. Fish Cult., 31(2): 99-108.

Fingerling coho salmon (Oncorhynchus kisutch) were introduced into Parvin Lake and Granby Reservoir in June 1963, and fingerling rainbow trout (Salmo gairdneri) were planted in both waters at approximately the same time. In Parvin Lake, the coho salmon grew more slowly, reached a smaller maximum size, contributed fewer fish to the creel, and migrated into the lake outlet much more extensively than the rainbow trout. In general, the Granby Reservoir plant showed opposite results, making further studies in similar environments seem worthwhile. In Parvin Lake, the coho salmon showed inherent resistance to an intestinal fluke (Crepidostomum farionis), and the rainbow trout, a low incidence of infection by tapeworms (Proteocephalus sp.). In Parvin Lake, several important food items were used in different proportions by coho salmon and rainbow trout. In Granby Reservoir, food habits of coho salmon appeared to be similar to those of rainbow trout. Differences in seasonal distribution of coho salmon in the two waters suggest that temperature influenced salmon movement in Parvin Lake but had little or no effect on it in Granby Reservoir. (Authors)

10674. DeRoche, Stuart E. (Dept. of Inland Fisheries and Game, Gorham, Me.). 1969. OBSERVATIONS ON THE SPAWNING HABITS AND EARLY LIFE OF LAKE TROUT. Progr. Fish Cult., 31(2): 109-113.

The spawning habits and early life of lake trout, Salvelinus namaycush, are described. Although lake trout may be on the spawning grounds as long as 3 weeks, actual spawning may occur in a 24- to 48-hour period. In Maine, evidence of lake trout spawning has not been found in water more than 4 feet deep. Bottom types used by spawning lake trout and sources of predation on the eggs are discussed. Lake trout fry remain in shallow water for only a very short time after absorbing the yolk sac, and migrations to deep water are rapid. Insects and crustacea form 100% of the diet of underyearling lake trout; fish make up 90% of the diet of lake trout older than 2 years. (Auth.)

10675. Mattson, Chester R., and Jack E. Bailey (Bur. of Commercial Fisheries Biological Lab., Auke Bay, Alaska). 1969. A FRAME FOR HOLDING JUVENILE SALMON DURING SPRAY MARKING. Progr. Fish Cult., 31(2): 118-120.

Two wood frames covered with nylon mesh facilitate the spray marking of pink (Oncorhynchus gorbuscha) and chum (O. keta) salmon fry. (Authors)

10676. Tracy, H.B. (Washington Dept. of Fisheries, Olympia, Wash.). 1969. RETENTION OF TAGS APPLIED WITH A SHALLOW-WATER TAGGING GUN. Progr. Fish Cult., 31(2): 108.

A short-term retention study was conducted on coho salmon (Oncorhynchus kisutch) and steelhead trout (Salmo gairdneri) to evaluate the tag losses experienced when a shallow-water tagging gun and FT-1 dart tags were used. Seventy-seven tags were applied, 3 were deleted, and 4 were lost, resulting in a tag loss of 5.4%. (Auth.)

10677. Marlborough, David (Welwyn Garden City, Herts, England). 1969. A CHEAP AND EASILY CONSTRUCTED FISH TRAP. Progr. Fish Cult., 31(2): 117.

A small collapsible fish trap made out of nylon sleeve netting is described. Its effectiveness in use over 2 winters in waters in eastern England is noted. (Auth.)

10678. Thrailkill, James R. (Bur. of Commercial Fisheries, Fishery-Oceanogr. Center, La Jolla, Calif.). 1969. ZOOPLANKTON VOLUMES OFF THE PACIFIC COAST, 1960. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 581. 50 p.

Basic data on volumes of zooplankton are given, together with data for all plankton hauls taken on survey cruises of the California Cooperative Oceanic Fisheries Investigations. Distribution charts showing relative areal zooplankton abundance by month are included. (Auth.)

10679. Wise, John P., and William W. Fox, Jr. (Bur. of Commercial Fisheries, Tropical Atlantic Biological Lab., Miami, Fla.). 1969. THE JAPANESE ATLANTIC LONGLINE FISHERY, 1965, AND THE STATUS OF THE YELLOWFIN TUNA AND ALBACORE STOCKS. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 582. 7 p.

Fishing effort reached nearly 100 million hooks in 1965, a level which is more than the yellowfin tuna stocks can support and remain commercially productive. As catch rates for yellowfin tuna decrease, more and more fishing will be directed toward albacore. (Authors)

10680. Alexander, R. McN. (Dept. of Zoology, Univ. College of North Wales, Bangor). 1969. THE ORIENTATION OF MUSCLE FIBRES IN THE MYOMERES OF FISHES. J. mar. biol. Ass. U.K., 49(2): 263-290.

The superficial red muscle fibres of gnathostome fishes run more or less longitudinally, but the deeper muscle fibres are arranged in complex three-dimensional patterns in which some of them make angles of 30° or more with the long axis of the fish. There are two basic patterns, of which one is found in all the myomeres of selachians, primitive bony fishes, Anguilla and Salmo. In the other teleosts which were examined this pattern is restricted to the last few myomeres, and a quite different pattern is found more anteriorly. In a fish with muscle fibres running longitudinally the lateral fibres would be able to contract far more than those near the vertebral column. However, from mathematical analyses included in this paper it appears that both the patterns which have been found should result in all the white fibres in a myomere contracting to a fairly similar extent when the fish bends. This seems likely to be advantageous because a muscle fibre of given intrinsic speed produces maximum power output at one particular rate of contraction. A given rate of contraction of the muscle fibres results in faster bending if the fibres are arranged in the typical teleost pattern than if they are arranged in the selachian pattern. The selachian pattern is probably retained in the caudal peduncles of teleosts because the faster bending is obtained only at the expense of weaker bending moments. The caudal peduncle is slender and would be less able to transmit large forces to the caudal fin if the teleost pattern of muscle fibres were continued to its posterior end. (Auth.)

10681. Bureau of Commercial Fisheries. 1969. LIST OF SPECIAL SCIENTIFIC REPORTS AND SPECIAL SCIENTIFIC REPORT--FISHERIES OF THE U. S. FISH AND WILDLIFE SERVICE. U. S. Fish and Wildlife Service Fishery Leaflet 624. 52 p.

10682. Russell, F.S. 1969. ON THE SEASONAL ABUNDANCE OF YOUNG FISH. XI. THE YEAR 1966. J. mar. biol. Ass. U.K., 49(2): 305-310.

The numbers of young fish, excluding clupeids, taken in a 2 m ring trawl in the plankton off Plymouth were as high in the year 1966 as they were during the 1920s and early 1930s. There is thus evidence that the period of decreased abundance which began after 1934 and has apparently persisted since then may have ended. The year 1966 was a very early year for spring spawners and this can be correlated with the high water temperatures prevailing in the early months of that year. A comparison is made between the sizes of fish retained by stramin and by the terylene material of which the ring trawl is now made. (Auth.)

10683. Roberts, B.L. 1969. THE CO-ORDINATION OF THE RHYTHMICAL FIN MOVEMENTS OF DOGFISH. J. mar. biol. Ass. U.K., 49(2): 357-425.

The muscle fibres of the radial muscles of the unpaired fins of dogfish can be divided into two populations—an outer group of red muscle fibres which are smaller and fewer than the inner white muscle fibres and which differ in structure, number of nuclei and pattern of innervation. Two types of potential were detected in the two muscle systems when recordings were made with implanted electrodes during movements of the fins. The red muscle fibres were associated with small, slow junctional potentials which changed in amplitude when the activity of the system was altered. In contrast, the white muscle fibres generated typical action potentials which altered in frequency with changing activity of the muscle fibres. The timing of the rhythm of fin and body movements was found to be dependent on the timing of sensory activity from body proprioceptors stimulated by the swimming movements. (Auth.)

10684. Dando, P.R. 1969. A GLUCOSEPHOSPHATE ISOMERASE INHIBITOR OF SEASONAL OCCURRENCE IN COD (Gadus morhua) AND OTHER FISH. J. mar. biol. Ass. U.K., 49(2): 447-453.

A heat-stable inhibitor of glucosephosphate isomerase (D-glucose-6-phosphate ketol-isomerase, E.C. 5.3.1.9) has been found in tissues of the cod (Gadus morhua L.). The inhibitor occurred in cod in the Plymouth area from February to mid-April in 1967 and from mid-March to mid-April in 1968. Gel filtration studies indicate that the inhibitory component of cod muscle has a molecular weight of less than 1500. A similar inhibitor has been found in red mullet (Mullus surmuletus L.), mergrim (Lepidorhombus whiffiagonis Walbaum) and greater forkbeard (Urophycis blennoides Brunnich). The inhibitor is of a seasonal nature in these fish also and may be linked with the spawning cycle. (Auth.)

10685. Gasaway, Charles R. 1967. THE SPORT FISHERY OF TENKILLER FERRY RESERVOIR, OKLAHOMA. Okla. Fish. Res. Lab. Bull. No. 7. 21 p.

An intensive creel survey was conducted on Tenkiller Ferry Reservoir, Oklahoma, in 1964 and 1965 to provide estimates of the sport fishing pressure and yield in different parts of the reservoir, and to study changes that have taken place in the sport fishery since earlier surveys were conducted in 1953 to 1956. In 1964-65 there was an estimated 33.1 man-hours per acre of daytime fishing, and at least half of this fishing pressure was exerted in the upper third of the reservoir. Night fishing was estimated at 2.4 man-hours per acre from Dec. 1, 1964 to June 30, 1965. Fishing pressure has declined considerably since 1955-56, when there was an estimated 111 man-hours per acre of annual fishing on the reservoir. Fifty percent of the daytime fishing and 91% of the night fishing was for crappie, followed by black bass, catfish, and white bass. The yield and catch rate were much higher in the upper third of the reservoir, except for smallmouth and spotted bass and possibly walleye, which were more often taken in the lower third. Heavier fishing pressure and shallower, more turbid water are possible explanations for the greater harvest in the upper reaches of the reservoir. Rotenone samples indicated that the standing crop of fish was probably higher in the lower end. The total yield for the reservoir was 11.85 pounds per acre; the catch rate was 0.58 fish or 0.34 pounds per hour; the average of the fish caught was 0.62 pounds. During the past 10 years there has been little change in the

average weight of the fish caught, but there has been a considerable decline in the yield of several species, especially bluegill and black crappie. Crappie now constitute 72% of the catch, but the percent of the catch consisting of the other sunfishes has greatly declined in the past 10 years. (Auth.)

10686. Ming, Arvil D. 1968. LIFE HISTORY OF THE GRASS PICKEREL, Esox americanus vermiculatus, IN OKLAHOMA. Okla. Fish. Res. Lab. Bull. No. 8. 66 p.

A study of the distribution, habitat, morphological characters, associated species, food habits, reproduction, age and growth, and parasites of the grass pickerel, Esox americanus vermiculatus, was studied in six counties of south-eastern Oklahoma. Grass pickerel were most abundant in the Little River system but rare in the Kiamichi River drainage except for Lake Raymond Gary. It appears that the pickerel distribution was once more extended and its present range decreasing. They were more commonly found in shallow, weedy portions of lakes and streams, and preferred dense submerged aquatic vegetation as opposed to open water areas under broad-leaved floating aquatics. Grass pickerel were rare in cutoff lakes, farm ponds, and the open flowing portions of rivers. Morphological characteristics indicated that Oklahoma pickerel tended to follow the characters listed for E. a. vermiculatus more closely than an intergrade form of E. a. americanus (redfin pickerel). Grass pickerel progressed from a diet of crustacea to insects to fish, with fish being the predominant food at lengths above 80 mm. Sunfishes were the most often occurring fish food, but young pickerel 30 to 199 mm selected darters while larger pickerel showed a prey selection based on relative abundance. Pickerel in Oklahoma spawn during late February or early March. They also spawn during the winter. Minimum size at sexual maturity was 118 mm for females; 109 mm for males during March, and they became sexually mature during their first year of life. Maximum age was age-group IV, with females being older and larger than males. Length-weight data revealed that male pickerel over 210 mm long from lakes were heavier than females of the same length. Stream pickerel were heavier at any given length than those from lakes. Two species of trematodes were found in pickerel stomachs, but their occurrence was confined to fish from the Little River drainage. (Auth.)

10687. Flis, Jozef. 1968. ANATOMICOHISTOPATHOLOGICAL CHANGES INDUCED IN CARP (Cyprinus carpio L.) BY AMMONIA WATER. PART I. EFFECTS OF TOXIC CONCENTRATION. PART II. EFFECTS OF SUBTOXIC CONCENTRATIONS. Acta Hydrobiol., 10(1/2): 205-224, 225-238.

A detailed report on the acute and prolonged effect of ammonia on carp. The chemical composition of water in which tested fish were maintained is given as well as exact amounts of ammonia expressed as NH_3 per liter. There is a detailed description of gross pathological and histopathological changes. Fourteen photomicrographs show histopathology of epidermis, muscles, gills, intestinal epithelium, liver and kidney. The report is in English and contains a list of mostly European references. --S.F. Snieszko.

10688. Fryer, Geoffrey. 1968. THE PARASITIC CRUSTACEA OF AFRICAN FRESHWATER FISHES; THEIR BIOLOGY AND DISTRIBUTION. J. Zool., Lond., 156(1): 45-95.

The known distribution of the parasitic crustaceans of African freshwater fishes, which now include some 80 more or less adequately described taxa, is summarized, and the significance of some of the patterns which they exhibit is discussed. Information is given on the taxonomy biology and evolution of certain species. (Auth.)

10689. Turner, William R. 1967. A PRE- AND POST-IMPOUNDMENT SURVEY OF MIDDLE FORK OF THE KENTUCKY RIVER. Kentucky Dept. of Fish and Wildlife Resources, Fisheries Bulletin No. 51. 71 p.

10690. Beardsley, Grant L., Jr. (Bur. of Commercial Fisheries, Tropical Atlantic Biological Lab., Miami, Fla.). 1969. DISTRIBUTION AND APPARENT RELATIVE ABUNDANCE OF YELLOWFIN TUNA (*Thunnus albacares*) IN THE EASTERN TROPICAL ATLANTIC IN RELATION TO OCEANOGRAPHIC FEATURES. Bull. mar. Sci., 19(1): 48-56.

An analysis is presented of the distribution and apparent relative abundance of yellowfin tuna (*Thunnus albacares*) in relation to thermal domes in the eastern tropical Atlantic. The distribution of catch rates of yellowfin tuna in the Japanese long-line fishery indicates that deep-swimming yellowfin are distributed around and downstream from the domes. The reason propounded in this paper is that upwelling in the domes and subsequent enrichment produce rich feeding areas for yellowfin tuna. (Auth.)

10691. Blackett, Roger F. 1968. SPAWNING BEHAVIOR, FECUNDITY, AND EARLY LIFE HISTORY OF ANADROMOUS DOLLY VARDEN, *Salvelinus malma* (Walbaum) IN SOUTHEASTERN ALASKA. Alaska Dept. of Fish and Game Research Report No. 6. 85 p.

The maturity composition of Dolly Varden migrating from the sea into Lake Eva on Baranof Island, Southeastern Alaska was inferred from a representative sample of 3,982 fish obtained at a weir in the lake outlet in 1964. Only 2.56% of 82,940 in-migrant fish was considered to have spawned in the system. Observations and maturity samples from stream systems without lakes in 1964 and at Hood Bay Creek, a non-lake stream on Admiralty Island, in 1965 indicated that the non-lake stream is of importance in providing spawning and rearing habitat. Egg diameter and ovary weight measurements correlated with time, maturity stage, and fish size provided a basis for describing the ovarian development cycle of the Dolly Varden. Ova size of the maturing eggs increased rapidly from July to mid-October. A maximum average egg diameter of 4.28 mm and a maturity index of 14.6% was calculated for the October sample. Fecundity relationships to body length and weight were compared between females collected from two non-lake streams, a lake, and a coastal river system of Southeastern Alaska. The spawning habits of anadromous Dolly Varden were studied at Hood Bay Creek in 1965. Between October 26 and November 4, spawning activity of 15 or fewer pairs was observed on a single site. The spawning behavior was characterized by male aggression, female digging, body pressing, and position holding over a redd. A total egg deposition estimate of 32,878 eggs and a spawner density estimate of approximately 17.8 females were derived by hydraulic sampling of the spawning site. The embryology of the Dolly Varden was studied by periodic examination of fertilized eggs held in a hatchery throughout the period of development. Development stages are correlated with time, water temperature, and temperature units to provide information on development rate at known water temperatures. The stages were also photographed to obtain an illustrative record of embryonic growth. Hatching of eggs began at 675 temperature units and 129 days after fertilization. The early life history of Dolly Varden was studied at Hood Bay Creek in 1965 and 1966. Winter survival of eggs to yolk sac fry was estimated to be about 41% from hydraulic sampling of the spawning site in the spring of 1966. The rearing habits and requirements, indicated by uniform sampling methods, involve seasonal trends of intra-stream movement, habitat preferences, and differential size group preferences. Age composition and growth rate of the rearing fish appeared quite similar to that of young fish in the Lake Eva system. (Auth.)

10692. Anderson, John M., and Margaret R. Peterson (Dept. of Biology, Carleton Univ., Ottawa, Canada). 1969. DDT: SUBLETHAL EFFECTS ON BROOK TROUT NERVOUS SYSTEM. Science, 164(3878): 440-441.

When brook trout are exposed for 24 hours to sublethal doses of DDT, the cold-blocking temperature for a simple reflex, which shows lability related to thermal history, is altered in a way suggesting that DDT is affecting the thermal acclimation mechanism. Sublethal dosage of DDT also prevents the establishment of a visual conditioned avoidance response. (Authors)

10693. Crane, J. W., and J. D. Mizelle (Sacramento State College, Sacramento, Calif.). 1968. STUDIES ON MONOGENETIC TREMATODES. XXXVII. A POPULATION STUDY OF TWO SPECIES OF ANCYROCEPHALINAE ON THE BLUEGILL IN CALIFORNIA. J. Parasit., 54(1): 49-50.

Urocleidus ferox Mueller, 1934, from the bluegill (7.5 to 10 cm SL) in Sacramento County (Calif.) showed an annual average of 15.1 specimens per fish and population peaks in August, January, and April. Similarly, *Actinocleidus fergusonii* Mizelle, 1938, showed an annual average of 3.3 specimens per fish and population peaks in July, January, and May. Developmental forms of these species occur in each month of the year in Sacramento County. (Authors)

10694. Stern, Daniel H. (Dept. of Zoology, Univ. of Illinois, Urbana, Ill.). 1968. A LIMNOLOGICAL INVESTIGATION OF THE MICROBIOTA OF AN ILLINOIS POND. Amer. Midl. Nat., 79(2): 476-498.

This study entailed an intensive one-year limnological investigation of the microbiota of a small Illinois pond with emphasis on physico-chemical interrelations and physico-chemical vs. organismal interactions. The numbers of organisms per liter belonging to a given taxon were determined, and these data were related to the physico-chemical data at a given time by means of multiple regression programs. Most phytoplankton populations were correlated with nitrate-nitrogen and water temperature. Less frequent negative correlations were observed with ammonia-nitrogen and nitrite-nitrogen, and positive or negative correlations occurred with total alkalinity. Diatoms were the first phytoplankters to produce a spring bloom. They were followed by desmids and other green algae. The presence of ciliate Protozoa usually was not correlated with any specific physico-chemical factor, lending credence to the supposition that their numbers and species composition are controlled by the presence and abundance of particulate food material. Several species belonging to the same genus, e.g., *Euglena* spp. and *Vorticella* spp., were present at the same time in samples collected from the pond. Intensive long-term sampling presented a panorama of the changes occurring in taxon composition and numbers of organisms within a period of several days and throughout the year. Sudden fluctuations in population size and taxon presence reemphasized the need for such intensive sampling during the studies of the interrelationships between taxa and the physico-chemical factors producing changes in the population density of the affected taxa. (Auth.)

10695. Werner, Robert G. (Dept. of Zoology, Indiana Univ., Bloomington, Ind.). 1969. ECOLOGY OF LIMNETIC BLUEGILL (*Lepomis macrochirus*) FRY IN CRANE LAKE, INDIANA. Amer. Midl. Nat., 81(1): 164-181.

In Crane Lake, Indiana, bluegill fry (*Lepomis macrochirus* Raf.) abandon littoral spawning areas shortly after yolk sac absorption and migrate to the limnetic zone of the lake. The ecology of the fry during their residence in the limnetic zone was studied utilizing data derived from fry captured in plexiglass fry traps. The distribution of the fry in the epilimnion is patchy, suggesting that they are aggregated possibly in schools. They feed upon crustacean zooplankters, selecting copepods in preference to other plankters. They demonstrate a diel periodicity in their activity with low activity during the day, peak activity at dusk, low activity at night, and a secondary peak of activity at dawn. They remain in the limnetic zone for approximately a month and a half, growing at a rate of 0.4 mm/day. After achieving a size of 22 to 25 mm, they return to the littoral zone. In 1965 the brief period of limnetic residence for bluegill fry suggested that the duration of successful spawning had been very short, although nest-building activity extended from May to August. (Auth.)

10696. Rabe, Fred W. (Dept. of Zoology and Entomology, Univ. of Utah, Salt Lake City, Utah). 1969. ARTIFICIAL FERTILIZATION OF A SMALL HIGH-ALTITUDE LAKE. Amer. Midl. Nat., 81(1): 281-284.

A small shallow alpine lake was treated with diammonium phosphate for two summers. Nannoplankton were found to increase from several thousand organisms per liter before treatment to several million cells after fertilization. Apparent winterkill reduced the fish numbers so that it was difficult to ascertain to what extent fertilization played a role in increased food consumption and growth of the brook trout. (Auth.)

10697. Lederis, Karl (Dept. of Zoology and Cancer Research Genetics Lab., Univ. of California, Berkeley, Calif.). 1969. TELEOSTEAN UROPHYSIS: STIMULATION OF CONTRACTIONS OF BLADDER OF THE TROUT Salmo gairdnerii. Science, 163(3873): 1327-1328.

A new activity of the teleost caudal neurosecretory system is described. Extracts of the urophysis of the mudsucker Gillichthys mirabilis and of the trout Salmo gairdnerii cause rhythmic contractions of the isolated urinary bladder of the trout. The dose-related response provides the basis for a quantitative bioassay of this urophysial principle. (Auth.)

10698. Maxfield, Galen H., Gerald E. Monan, and Holbrook L. Garrett (Bur. of Commercial Fisheries Biological Lab., Seattle, Wash.). 1969. ELECTRICAL INSTALLATION FOR CONTROL OF THE NORTHERN SQUAWFISH. U.S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 583. 14 p.

Electricity was used experimentally to divert and trap squawfish during their spawning migration in 1958 at Cascade Reservoir, Idaho. Electrical fields, created by sequentially energizing a V-shaped array of vertically suspended round electrodes with square-wave, d.c. pulses, were evaluated as a means of diverting squawfish into traps. Three test conditions of varied pulse frequency, pulse duration, and voltage were tested. Two sets had a pulse frequency of 10 pulses per second (2 per field per second when five fields were pulsed in sequence), a pulse duration of 50 msec., and voltages of 140 and 180 v; one set had a pulse frequency of 15 pulses per second (3 per field), a pulse duration of 25 msec., and a voltage of 180 v. One set (pulse frequency, 10 pulses per second; pulse duration, 50 msec; and voltage, 180 v) was repeated. The electrical fields of the electrode array were effective in diverting squawfish into traps. The test condition with pulse frequency of 15 pulses per second, pulse duration of 25 msec, and voltage of 180 v was less effective than the other test conditions. (Authors)

10699. PULLEN, Edward J. (Bur. of Commercial Fisheries Biological Lab., Galveston, Texas). 1969. HYDROLOGICAL CONDITIONS IN CLEAR LAKE, TEXAS, 1958-66. U.S. Fish and Wildlife Service Special Scientific Report--Fisheries No., 578. 8 p.

Temperature and salinity data were collected in 1958-66, and dissolved oxygen, dissolved organic nitrogen, and total phosphorus analyses were made on samples collected in 1964-66 in Clear Lake, a small estuary that flows into upper Galveston Bay. Seasonal trends in bottom water temperature were similar in the different years and were related closely to trends in air temperature. Average water temperatures were lowest (about 13° C) in January and February and highest (about 31° C) in July. The rate of warming and cooling was directly related to the magnitude of the annual temperature difference between the warm and cool months. Salinity ranged from 0.1 to 23.7 ppt (parts per thousand) and was related inversely to stream flow and precipitation. Variations in rainfall resulted in fluctuations in stream flow and these, in turn, were reflected by variations in salinity. Dissolved organic nitrogen ranged from 23.5 to 171.5 µg at/l (microgram atoms per liter) and averaged 66.4 µg at/l. Total phosphorus ranged from 1.7 to 26.3 µg at/l and averaged 8.2 µg at/l. Phosphorus values increased markedly in July 1966. No correlation existed between nitrogen or phosphorus and stream flow or rainfall. Dissolved oxygen ranged from 3.8 to 19.3 ppm. (Auth.)

10700. Olla, Bori L., and Warren W. Marchioni (Bur. of Sport Fisheries and Wildlife, Sandy Hook Marine Lab., Highlands, N.J.). 1968. RHYTHMIC MOVEMENTS OF CONES IN THE RETINA OF BLUEFISH, Pomatomus saltatrix, HELD IN CONSTANT DARKNESS. Biol. Bull., Woods Hole., 135(3): 530-536.

The retina of bluefish, Pomatomus saltatrix, undergoes photomechanical changes in response to light and darkness. Complete light-adaption requires between 15 and 30 minutes, complete dark-adaption between 30 and 60 minutes. Retinal cones of juvenile bluefish held under continuous darkness for two days exhibited a diurnal retinomotor rhythm. The epithelial pigment layer remained in a dark-adapted condition throughout the two days and displayed no discernible expansion. Results were related with activity rhythms of bluefish and suggested that internal control of a retinomotor rhythm may predispose the eye to environmental changes in light intensity. (Authors summ.)

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